CMMI V1.1 and Appraisal Tutorial

Mike Phillips, CMMI Program Manager

Agenda

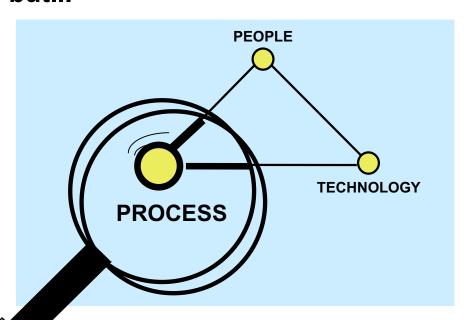- **Why focus on Process?**

- **Background – Why use a Model?**

- **CMMI Structure**

- **Comparisons with SW-CMM v1.1**

- **Process Areas Overview**

- **Appraisal Methodology**

- **Training**

Quality Leverage Points

Everyone realizes the importance of having a motivated, quality work force but...

PEOPLE

PROCESS

TECHNOLOGY

Major determinants of product cost, schedule, and quality

- **...even our finest people can't perform at their best when the process is not understood or operating "at its best."**

General Definition of Process

- **How do you define process?**

- **A process is a set of practices performed to achieve a given purpose; it may include tools, methods, materials, and/or people.**

- **While process is often described as a leg of the process-people-technology triad, it may also be considered the "glue" that unifies the other aspects.**

Why Focus on Process?

- Process provides a constructive, high-leverage focus...
    - as opposed to a focus on people
        - **Your work force, on the average, is as "good" as it is *trained* to be.**
        - **Working harder is not the answer.**
        - **Working smarter, through process, is the answer.**
    - as opposed to a focus on technology
        - **Technology applied without a suitable roadmap will not result in significant payoff.**
        - **Technology provides the most benefit in the context of an appropriate process roadmap.**

Underlying Premise of Process Improvement

"The quality of a product is largely determined by the quality of the process that is used to develop and maintain it."

Based on TQM principles as taught by Shewhart, Juran, Deming and Humphrey.

Early Process Improvement

- The theories of process management are a synthesis of the concepts of Deming, Crosby, Juran, and others.

- Over the past 30 years, these theories have been used to address problems common to many organizations.

- Solutions have been discovered, but a gap existed between the state of the practice and the state of the art.

- Many of these concepts have been used to build process-improvement *models*.

What Is a Process Model?

- A model is a structured collection of elements that describe characteristics of effective processes.

- Processes included are those proven by experience to be effective.

How Is a Model Used?

- **to help set process improvement objectives and priorities, improve processes, and provide guidance for ensuring stable, capable, and mature processes**

- **as a guide for improvement of organizational processes**
  - a place to start
  - shares the benefit of a community's prior experiences
  - a common language and a shared vision
  - simplified approximations of reality that provide insight
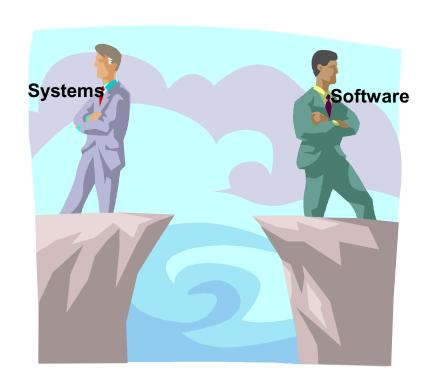
"All models are wrong, but some are useful."
  - **George Box**

The Problem

- **Systems and software disciplines have traditionally not been well integrated**

- **The importance of software in systems has increased dramatically**
  - **Example: % of requirements allocated to software: ***
    - » **B-2 Stealth Bomber-- 65%**
    - » **F-22 Raptor -- 80%**

- **The DOD has emphasized the need to make the systems/software interface more seamless**
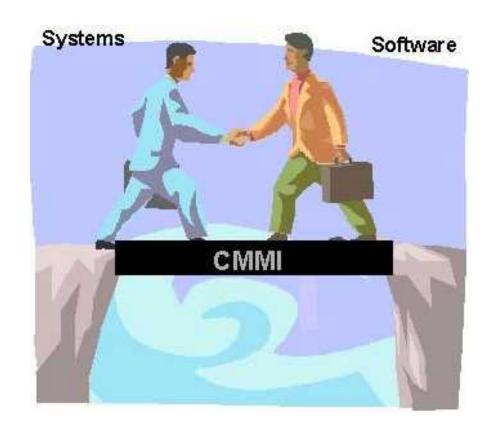
Systems

Software

* Source: Standish Group *Chaos Report*

Bridging the Divide

- **Systems engineering and software engineering processes are integrated.**

- **Integrates systems and software disciplines into one process improvement framework.**

- **Provides a framework for introducing new disciplines as needs arise.**

But We Don't Do That...

- Some organizations see themselves as performing just one discipline
  - Software
  - Systems
  - Acquisition

- But…
  - Software always must be part of some kind of system
  - Systems that don't have software are rare
  - Acquisition can involve both

- Communication and cooperation with other disciplines, even if they are external to our organization is vital

The CMMI Project

- **DoD sponsored collaboration between industry, Government, SEI**

- **Over 100 people involved**

  - U.S. Army, Navy, Air Force
  - Federal Aviation Administration
  - National Security Agency
  - Software Engineering Institute
  - ADP, Inc.
  - AT&T Labs
  - BAE
  - Boeing
  - Computer Sciences Corporation
  - EER Systems
  - Ericsson Canada
  - Ernst and Young
  - General Dynamics
  - Harris Corporation
  - Honeywell
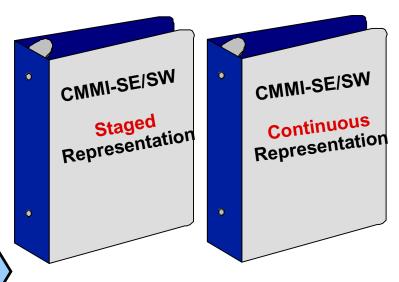
  - KPMG
  - Lockheed Martin
  - Motorola
  - Northrop Grumman
  - Pacific Bell
  - Q-Labs
  - Raytheon
  - Reuters
  - Rockwell Collins
  - SAIC
  - Software Productivity Consortium
  - Sverdrup Corporation
  - TeraQuest
  - Thomson CSF
  - TRW

CMMI Models

Source Models

- **Capability Maturity Model for Software V2, draft C (SW-CMM V2C)**

- **EIA Interim Standard 731, System Engineering Capability Model (SECM)**

- **Integrated Product Development Capability Maturity Model, draft V0.98 (IPD-CMM)**

CMMI-SE/SW

Staged Representation

CMMI-SE/SW

Continuous Representation

- Combined System Engineering / Software Engineering model

- Can be applied to:
  - Just the software engineering projects in an organization
  - Just the system engineering projects in an organization
  - Both
  - IPPD can be used in either/both

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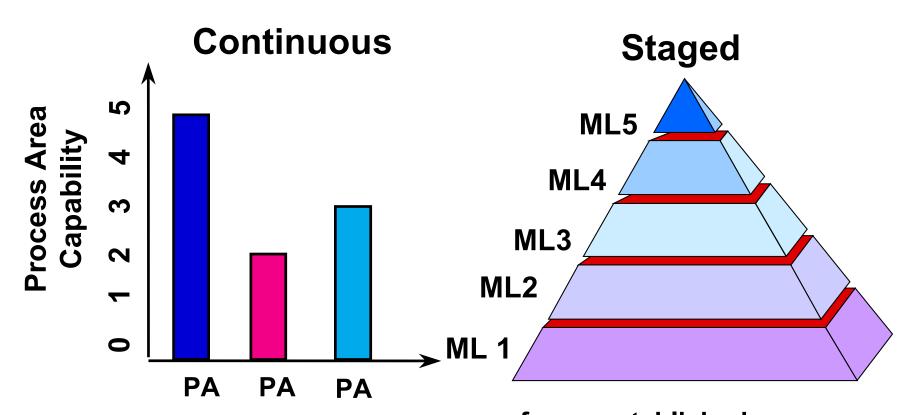
Advantages of Each Representation

Continuous Representation	Staged Representation
Provides maximum flexibility for order of process improvement	**Predefined and proven path with case study and ROI data**
High visibility of improvement within process areas	**Focuses on organizational improvement**
Easy upgrade from EIA 731	**Easy upgrade from SW-CMM**
Easy comparison to ISO 15504	**Provides familiar benchmarking capability**
Improvement of process areas can occur at different rates	**Overall results summarized in a maturity level**

Comparing
Model Representations

Continuous

Process Area Capability

5
4
3
2
1
0

PA   PA   PA

ML 1

. . .for a single process area or a set of process areas

Staged

ML5
ML4
ML3
ML2
ML 1

. . .for an established set of process areas across an organization

Relating Process Area Capability and Organizational Maturity $_1$

- Process area capability and organizational maturity are similar concepts.

- The difference between them is that process area capability deals with a set of processes relating to a *single process area* or specific practice, while organizational maturity pertains to a set of process areas *across an organization*.

CMMI Product Suite

- **Models**
  - **Disciplines**
    - »Systems Engineering SE
    - »Software Engineering SW
    - »Integrated Product and Process Development (IPPD)
    - »Supplier Sourcing (SS)
  - **Representations**
    - »Staged
    - »Continuous

- **Training**
  - **Model**
    - »Introduction to CMMI
    - »Intermediate Concepts
  - Instructor Training
  - Lead Appraiser

- **Appraisal methods**
  - **Appraisal Requirements for CMMI (ARC)**
  - **SCAMPI** Method Description Document (MDD)

The Bottom Line [1]

• **Process improvement should be done to help the business— not for its own sake.**

"In God we trust, all others bring data."

- W. Edwards Deming

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The Bottom Line 2

- **Improvement means different things to different organizations:**

  – **What are your business goals?**

  – **How do you measure progress?**

- **Improvement is a long-term, strategic effort:**

  – **What is the expected impact on the bottom line?**

  – **How will impact be measured?**
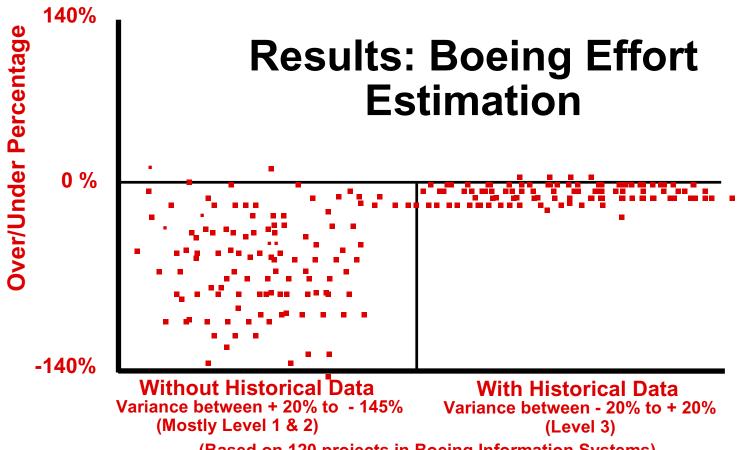
Categories of Process Improvement Benefits

- **Process improvement benefits fall into one of eight general categories:**
  - improved schedule and budget predictability
  - improved cycle time
  - increased productivity
  - improved quality (as measured by defects)
  - increased customer satisfaction
  - improved employee morale
  - increased return on investment
  - decreased cost of quality

Improved Schedule and Budget Predictability

CMMI

Results: Boeing Effort Estimation

Over/Under Percentage (y-axis: 140%, 0%, -140%)

Without Historical Data
Variance between + 20% to - 145%
(Mostly Level 1 & 2)

With Historical Data
Variance between - 20% to + 20%
(Level 3)
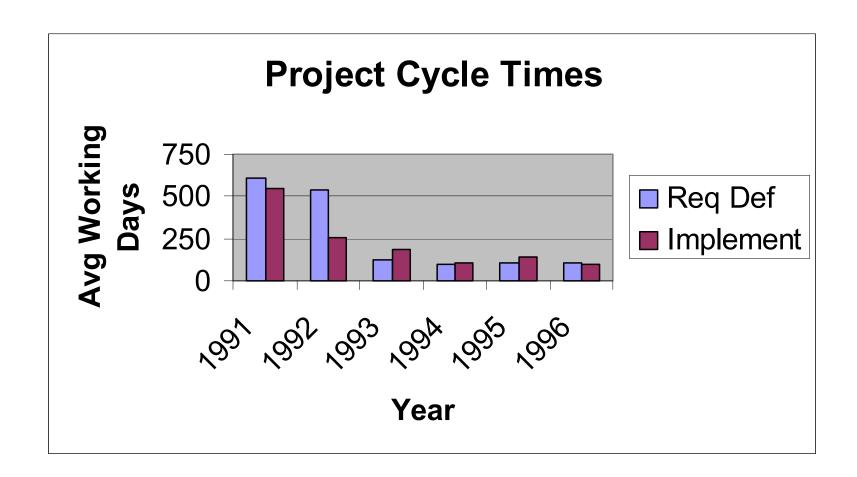
(Based on 120 projects in Boeing Information Systems)

Reference: John D. Vu. "Software Process Improvement Journey:From Level 1 to Level 5."
7th SEPG Conference, San Jose, March 1997.

Improved Cycle Time
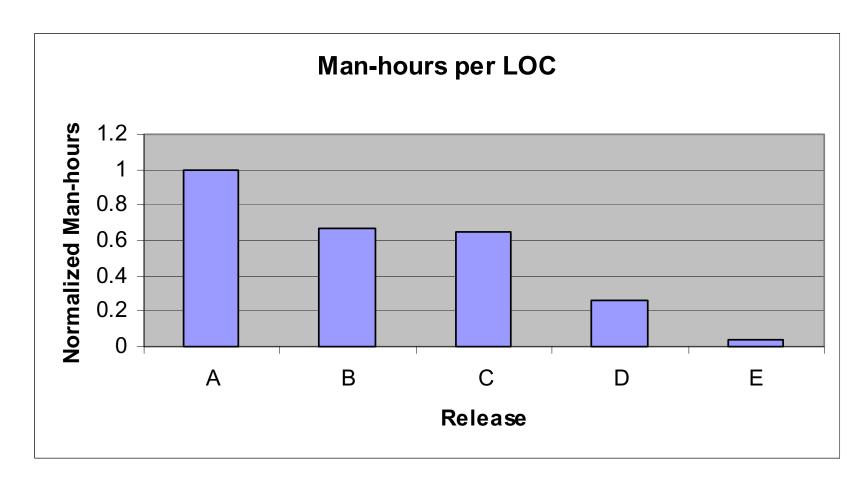
Project Cycle Times

Avg Working Days (y-axis): 0, 250, 500, 750

Legend:
- Req Def
- Implement

Year (x-axis): 1991, 1992, 1993, 1994, 1995, 1996

Source: Software Engineering Div., Hill AFB, Published in Crosstalk May 1999

Increased Productivity

Man-hours per LOC
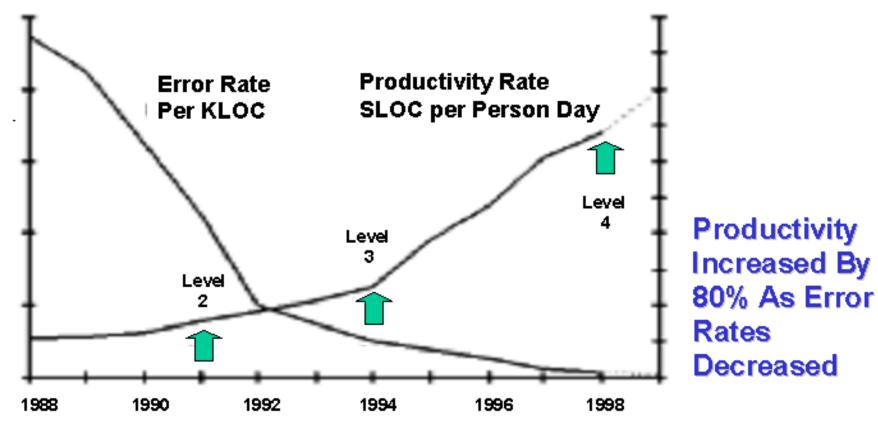
Source: Software Engineering Div., Hill AFB, Published in Crosstalk May 1999

Increased Productivity and Quality

Productivity Rate and Quality Performance
* For Software Programs

Error Rate Per KLOC

Productivity Rate SLOC per Person Day

Level 2

Level 3

Level 4

Productivity Increased By 80% As Error Rates Decreased

1988 1990 1992 1994 1996 1998

Topics

- **The structure of the CMMI documents**

- **The structure of the CMMI Continuous representation**

- **The structure of the CMMI Staged representation**

- **Summary**

Organization of
Continuous Model -1

- **Six chapters provide an overview**
  - **The Introduction**
  - **Structure of the Model**
  - **Model Terminology**
  - **Capability Level and Generic Model components**
  - **Understanding the Model**
  - **Using the Model**

Organization of
Continuous Model -2

- **Process areas**
  - »Process management
  - »Project Management
  - »Engineering
  - »Support

- **Appendixes**
  - »References
  - »Acronyms
  - »Glossary
  - »Required and expected Model Elements
  - »CMMI Project Participants
  - »Equivalent Staging

Organization of
Staged Model -1

- **Six chapters provide an overview**
  - **The Introduction**
  - **Structure of the Model**
  - **Model Terminology**
  - **Maturity Levels, Common Features, and Generic Practices**
  - **Understanding the Model**
  - **Using the Model**

Organization of
Staged Model -2

- **Process areas**
  - »Maturity Level: 2 Managed
  - »Maturity Level: 3 Defined
  - »Maturity Level: 4 Quantitatively Managed
  - »Maturity Level: 5 Optimizing

- **Appendixes**
  - »References
  - »Acronyms
  - »Glossary
  - »Required and expected Model Elements
  - »CMMI Project Participants
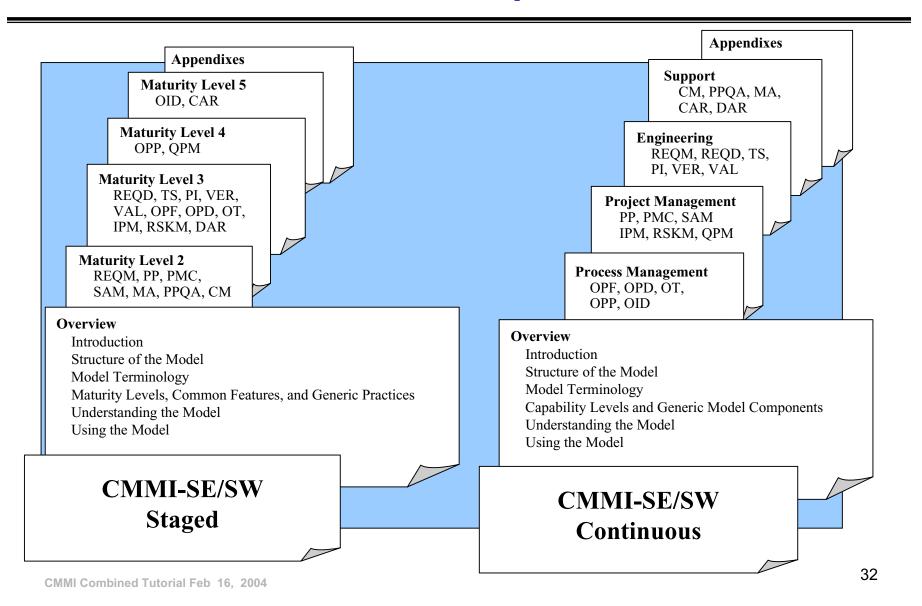
Model Components

- **Process Areas**
  - **Specific Goals**
  - **Specific Practices**
  - **Generic Goals**
  - **Generic Practices**
    - »Typical Work Products
    - »Sub-practices
    - »Notes
    - »Discipline Amplifications
    - »Generic Practice Elaborations
    - »References

CMMI Structure
One Model, Two Representations

CMMI

Appendixes

Maturity Level 5
OID, CAR

Maturity Level 4
OPP, QPM

Maturity Level 3
REQD, TS, PI, VER,
VAL, OPF, OPD, OT,
IPM, RSKM, DAR

Maturity Level 2
REQM, PP, PMC,
SAM, MA, PPQA, CM

Overview
Introduction
Structure of the Model
Model Terminology
Maturity Levels, Common Features, and Generic Practices
Understanding the Model
Using the Model

CMMI-SE/SW
Staged

Appendixes

Support
CM, PPQA, MA,
CAR, DAR

Engineering
REQM, REQD, TS,
PI, VER, VAL

Project Management
PP, PMC, SAM
IPM, RSKM, QPM

Process Management
OPF, OPD, OT,
OPP, OID

Overview
Introduction
Structure of the Model
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Capability Levels and Generic Model Components
Understanding the Model
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CMMI-SE/SW
Continuous

Topics

- **Structure of the CMMI documents**

➔ - **The structure of the CMMI continuous representation**

- **The structure of the CMMI staged representation**

- **Summary**

Process Area Capability Profile

A process area capability profile may be represented by a set of points in two dimensions.

- the *process dimension*
  - » "What" you do
- the *capability dimension*
  - » "How well" you do it

Capability (How well)
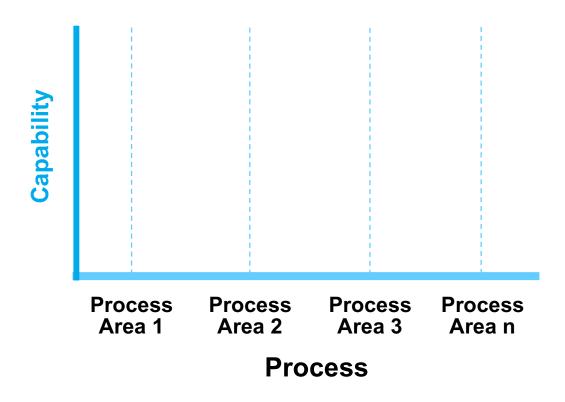
Process Area (What you do)

The Process Dimension

- **The values on this axis describe what processes (described within *Process Areas*) you perform.**

The y-axis is labeled **Capability** and the x-axis is labeled **Process** with markers for **Process Area 1**, **Process Area 2**, **Process Area 3**, and **Process Area n**.
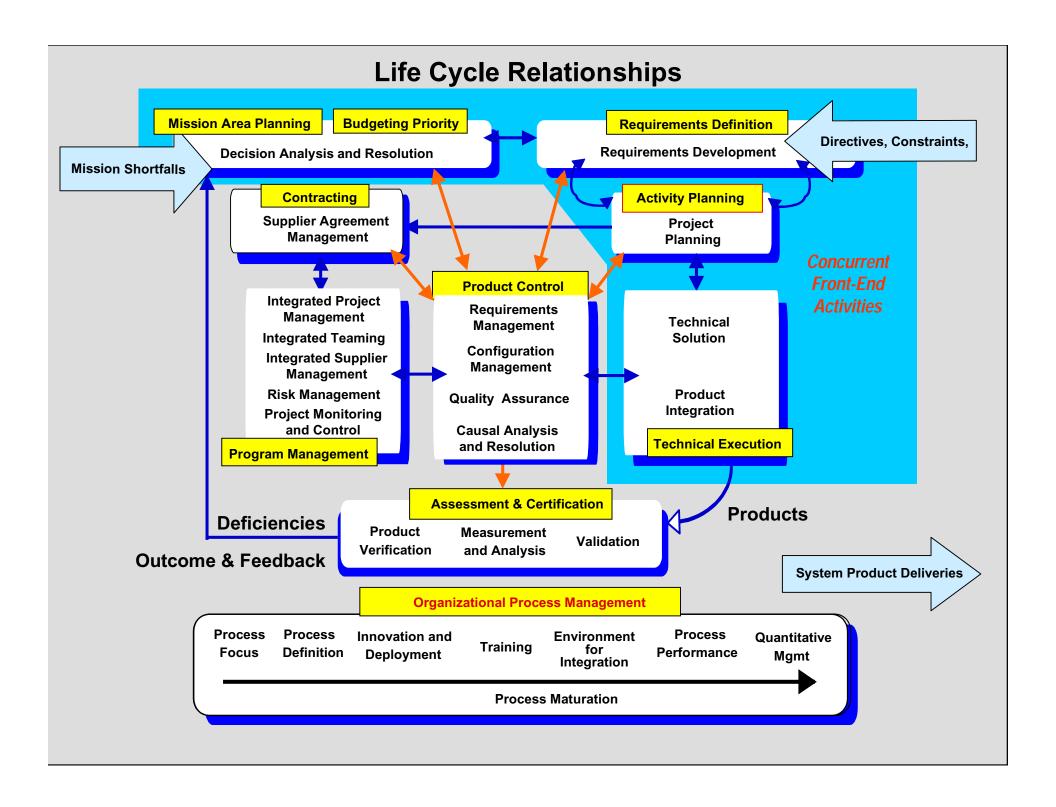
Process Areas

- *Process Areas* (PAs) are a cluster of related practices.

- They are the major building blocks in establishing process capability.

- Example PA: "Requirements Management"

Continuous
Organization of Process Areas

Category	Process Area
Project Management	**Project Planning** **Project Monitoring and Control** **Supplier Agreement Management** **Integrated Project Management(IPPD)** **Integrated Supplier Management (SS)** **Integrated Teaming (IPPD)** **Risk Management** **Quantitative Project Management**
Support	**Configuration Management** **Process and Product Quality Assurance** **Measurement and Analysis** **Causal Analysis and Resolution** **Decision Analysis and Resolution** **Organizational Environment for Integration (IPPD)**
Engineering	**Requirements Management** **Requirements Development** **Technical Solution** **Product Integration** **Verification** **Validation**
Process Management	**Organizational Process Focus** **Organizational Process Definition** **Organizational Training** **Organizational Process Performance** **Organizational Innovation and Deployment**

Life Cycle Relationships

Mission Area Planning **Budgeting Priority** **Requirements Definition**

Decision Analysis and Resolution

Requirements Development

Mission Shortfalls

Directives, Constraints,

Contracting

Supplier Agreement Management

Activity Planning

Project Planning

Concurrent Front-End Activities

Product Control

Integrated Project Management

Integrated Teaming

Integrated Supplier Management

Risk Management

Project Monitoring and Control

Program Management

Requirements Management

Configuration Management

Quality Assurance

Causal Analysis and Resolution

Technical Solution

Product Integration

Technical Execution

Assessment & Certification

Product Verification

Measurement and Analysis

Validation

Deficiencies

Products

Outcome & Feedback

System Product Deliveries

Organizational Process Management

Process Focus

Process Definition

Innovation and Deployment

Training

Environment for Integration

Process Performance

Quantitative Mgmt

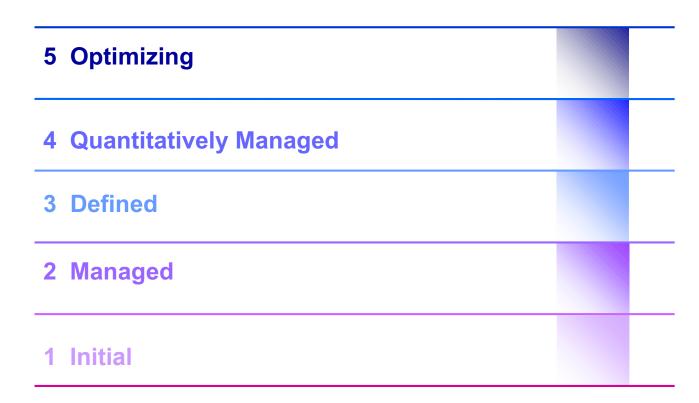**Process Maturation**

Capability Levels

- **A capability level is a well-defined evolutionary plateau describing the capability of a *process area*.**

- **There are six capability levels.**

- **Each level is a layer in the foundation for continuous process improvement.**

- **Thus, capability levels are cumulative, i.e., a higher capability level includes the attributes of the lower levels.**

The Capability Levels

5 Optimizing

4 Quantitatively Managed

3 Defined

2 Managed

1 Initial
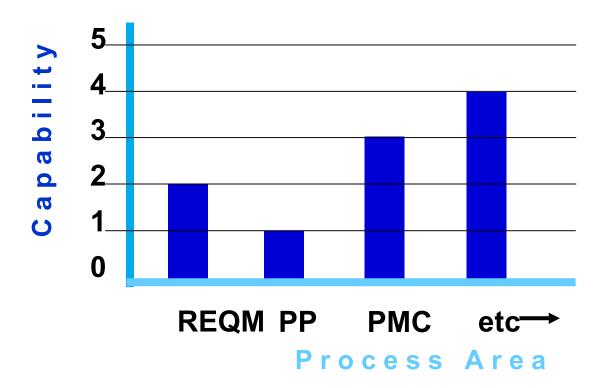
0 Incomplete

An Example Process Area Capability Profile

Goals and Practices

- *Goals* and *Practices* are the model elements used to realize the values on both the capability and process dimensions.
  - **Goal**
    - » A high level statement of the outcome to be achieved by effective implementation of a group of practices. (These are "required.")
  - **Practice**
    - » A description of an action that is necessary to enact a key element of a process area. (These are "expected," and "alternate practices" are acceptable.)

Specific and Generic Goals and Practices

- **Specific Goals and Specific Practices**
    - **realize the process dimension**
    - **therefore, they apply to a particular Process Area**

- **Generic Goals and Generic Practices**
    - **realize the capability dimension**
    - **therefore, they apply across all Process Areas**

Critical Distinctions

• performed   vs.   managed

•--the extent to which the process is planned; performance is managed against the plan; corrective actions are taken when needed

•managed   vs.   defined

•--the scope of application of the process descriptions, standards, and procedures (i.e., project vs. organization)

•defined   vs.   quantitatively managed

•--the predictability of process performance

•quantitatively managed   vs.   optimizing

•--the process is continuously improved by addressing common causes of process variation

Improving a Process Area

CMMI

GP1.1 through GP5.2 **CL1+CL2*+CL3* SPs**	**CL5** **Optimizing**	Defect prevention, proactive improvement, innovative technology insertion and deployment
GP1.1 through GP4.2 **CL1+CL2*+CL3* SPs**	**CL4** **Quantitatively Managed**	Measure process performance, stabilize process, control charts, deal with causes of special variations
GP1.1 through GP3.2 **CL1+CL2*+CL3* SPs**	**CL3** **Defined**	Project's process is tailored from organization's standard processes, understand process qualitatively, process contributes to the organizations assets
GP1.1 through GP2.10 **CL1 + CL2* SPs**	**CL2** **Managed**	Adhere to policy, follow documented plans and processes, apply adequate resources, assign responsibility and authority, train people, apply CM, monitor, control, and evaluate process, identify and involve stakeholders, review with management
GP1.1 **CL1 (base) SPs**	**CL1** **Performed**	Perform the work
No GPs or SPs exist	**CL0**	Not performed, incomplete

* Advanced practices exist only in the Engineering PAs.

REQM - Capability Levels 1 & 2

Requirements Management

Specific practices (CL1 - "base")

SP1.1-1: Obtain an Understanding of
            Requirements
SP1.3-1: Manage Requirements Changes
SP1.5-1: Identify Inconsistencies Between
           Project Work and Requirements

Generic practices (CL1)

GP1.1: Perform Base Practices

Specific practices (CL2 - "advanced")

SP1.2-2: Obtain Commitment to Requirements
SP1.4-2: Maintain Bidirectional Traceability of
           Requirements

Generic practices (CL2)

GP2.1: Establish an Organizational Policy
GP2.2: Plan the Process
GP2.3: Provide Resources
GP2.4: Assign Responsibility
GP2.5: Train People
GP2.6: Manage Configurations
GP2.7: Identify and Involve Relevant Stakeholders
GP2.8: Monitor and Control the Process
GP2.9: Objectively Evaluate Adherence
GP2.10: Review Status with Higher Level Management

REQM - Capability Level 3

Requirements Management

Specific practices (CL1 & CL2)

SP1.1-1: Obtain an Understanding of
Requirements
SP1.2-2: Obtain Commitment to Requirements
SP1.3-1: Manage Requirements Changes
SP1.4-2: Maintain Bidirectional Traceability of
Requirements
SP1.5-1: Identify Inconsistencies Between
Project Work and Requirements

Generic practices (CL1 & CL2)

GP1.1: Perform Base Practices
GP2.1: Establish an Organizational Policy
GP2.2: Plan the Process
GP2.3: Provide Resources
GP2.4: Assign Responsibility
GP2.5: Train People
GP2.6: Manage Configurations
GP2.7: Identify and Involve Relevant Stakeholders
GP2.8: Monitor and Control the Process
GP2.9: Objectively Evaluate Adherence
GP2.10: Review Status w/Higher Level Management

Specific practices (CL3)

All the CL1 & CL2 Specific Practices

Generic practices (CL3)

All the CL1 & CL2 Generic Practices plus(+):

GP3.1: Establish a Defined Process
GP3.2: Collect Improvement Information

REQM - Capability Levels 4 & 5

Requirements Management

Specific practices (CL4)

All the CL1 & CL2 Specific Practices

Generic practices (CL4)

All the CL1 & CL2 & CL3 Generic Practices plus(+):

GP4.1: Establish Quantitative Objectives for the Process
GP4.2: Stabilize Subprocess Performance

Specific practices (CL5)

All the CL1 & CL2 Specific Practices

Generic practices (CL5)

All the CL1 & CL2 & CL3 & CL4 Generic Practices plus(+):

GP5.1: Ensure Continuous Process Improvement
GP5.2: Correct Root Causes of Problems

Summary

- **CMMI models were developed with broad participation and review.**

- **Process Areas identify "what you do."**

- **Capability Levels identify "how well you do it."**

Topics

- **Structure of the CMMI documents**

- **The structure of the CMMI Continuous representation document**

➤ • **The Structure of the CMMI Staged representation**

- **Summary**
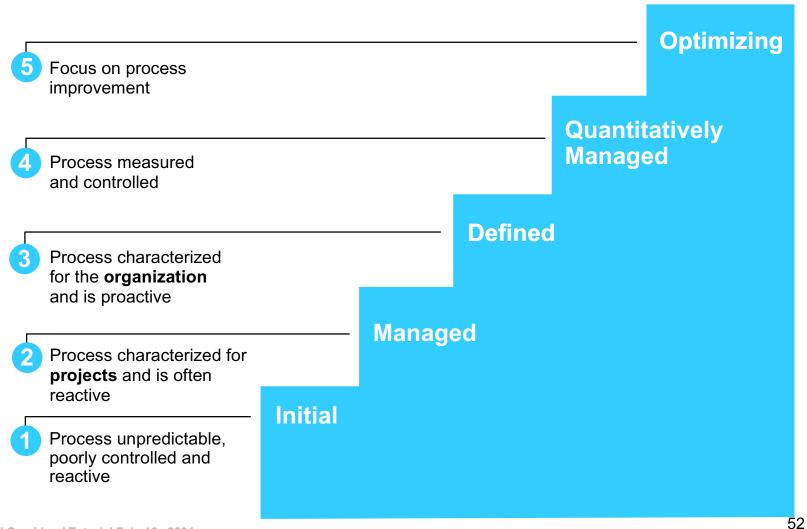
Maturity Levels

- **A maturity level is a well-defined evolutionary plateau on the path to becoming a mature organization.**

- **There are five maturity levels.**

- **Each level is a layer in the foundation for continuous process improvement.**

The Maturity Levels

5 Focus on process improvement

4 Process measured and controlled

3 Process characterized for the **organization** and is proactive

2 Process characterized for **projects** and is often reactive

1 Process unpredictable, poorly controlled and reactive

Initial

Managed

Defined

Quantitatively Managed

Optimizing
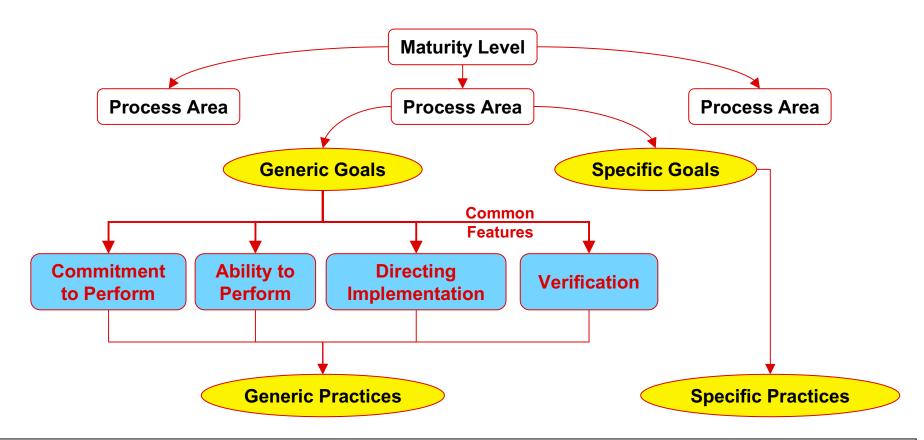
Structure of the CMMI Staged Representation

Commitment to Perform: creates policies and secures sponsorship for process improvement efforts
Ability to Perform: ensures that the project and/or organization has the resources it needs to pursue process improvement
Directing Implementation: collects, measures, and analyzes data related to processes
Verification: verifies that the projects and/or organization's activities conform to requirements, processes, and procedures

Maturity Levels
Cannot Be Skipped

- A level provides a necessary foundation for effective implementation of processes at the next level.

    – Higher level processes are easily sacrificed without the discipline provided by lower levels.

    – The effect of innovation is obscured in a noisy process.

- Higher maturity level processes may be performed by organizations at lower maturity levels, with risk of not being consistently applied in a crisis.

Process Areas

- *Process Areas* (PAs) are clusters of related practices performed collectively to achieve a set of goals.

- They are the major building blocks in establishing the process capability of an organization.

- Each process area has been defined to reside at a given maturity level.

Process Areas by Maturity Level

Level	Focus	Process Areas
5 Optimizing	*Continuous process improvement*	Organizational Innovation and Deployment Causal Analysis and Resolution
4 Quantitatively Managed	*Quantitative management*	Organizational Process Performance Quantitative Project Management
3 Defined	*Process standardization* *(SS)* *(IPPD)* *(IPPD)*	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Management Integrated Supplier Management Risk Management Decision Analysis and Resolution Organizational Environment for Integration Integrated Teaming
2 Managed	*Basic project management*	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
1 Initial		

Common Features

Common features are a means of categorizing Generic practices.

- *Commitment to perform:* establishment of management policies

- *Ability to perform:* establishment and maintenance of plans, resources, assigned responsibility and authority, and training

- *Directing implementation:* measurement, control, and performance practices

- *Verification:* ensure implementation and compliance

Another way to look at Common Features -1

- **Common feature categories are very similar across process areas.**

- **They are referred to as Institutionalization Common Features because they:**

  - **ensure the process areas are effective, repeatable and lasting**

  - **provide needed infrastructure support**

Common Feature Examples -1
from Requirements Management Process Area

- *Commitment to perform:*

    – **Establish and maintain an organizational policy for planning and performing the requirements management process.**

- *Ability to perform:*

    – **Train the people performing or supporting the requirements management process as needed.**

Common Feature Examples -2
from Requirements Management Process Area

- *Directing implementation:*

  – **Place designated work products of the requirements management process under appropriate levels of configuration management.**

- *Verification:*

  – **Review the activities, status, and results of the requirements management process with higher level management and resolve issues.**

Summary -1

- **There is one CMMI Model with two representations, Staged and Continuous.**

- **The material in both representations is the same just organized differently.**

- **Each representation provides different ways of implementing processes**

- **The CMMI model should be applied using intelligence, common sense, and professional judgment.**

Summary -2

- **Continuous**
  - **Flexible in its application so the organization can choose which areas to emphasize.**
  - **Provides equivalent staging to compare to staged representation.**

- **Staged**
  - **Structured for implementation based on proven grouping and ordering of processes.**

CMMI-SE/SW
Compared to SW-CMM v1.1

SW-CMM v1.1 vs. CMMI
Process Areas

**LEVEL 5
OPTIMIZING**

Defect Prevention ⟶ Causal Analysis and Resolution
Technology Change Mgmt ⟶ Organizational Innovation & Deployment
Process Change Management

**LEVEL 4
MANAGED**

Quantitative Process Mgmt ⟶ Organizational Process Performance
Software Quality Mgmt ⟶ Quantitative Project Management

Organization Process Focus   Organization Process Focus
Organization Process Definition   Organization Process Definition
Training Program   Organizational Training
Integrated Software Mgmt   Integrated Project Management
                                    Risk Management
Software Product Engr   **Requirements Development**
                                    Technical Solution
                                    Product Integration
Intergroup Coordination   **Verification**
Peer Reviews   **Validation**

**LEVEL 3
DEFINED**

                                    Decision Analysis and Resolution

Requirements Management   Requirements Management
Software Project Planning   Project Planning
Software Project Tracking & Oversight Project Monitoring and Control
Software Subcontract Mgmt   Supplier Agreement Management
Software Quality Assurance   Product & Process Quality Assurance
Software Configuration Mgmt   Configuration Management

**LEVEL 2
REPEATABLE**

                                    Measurement and Analysis

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CMMI Improvements
Over the CMM

- **Emphasis on measurable improvements to achieve business objectives.**

- **Process areas have been added to place more emphasis on some important practices:**
  - **Risk Management**
  - **Measurement and Analysis**
  - **Engineering Process Areas**
  - **Decision Analysis**

Overview of CMMI^{SM} SE/SW/IPPD/SS Model Process Areas

Continuous
Organization of PAs

CMMI

Category	Process Area
Project Management	**Project Planning** **Project Monitoring and Control** **Supplier Agreement Management** **Integrated Project Management(IPPD)** **Integrated Supplier Management (SS)** **Integrated Teaming (IPPD)** **Risk Management** **Quantitative Project Management**
Support	**Configuration Management** **Process and Product Quality Assurance** **Measurement and Analysis** **Causal Analysis and Resolution** **Decision Analysis and Resolution** **Organizational Environment for Integration (IPPD)**
Engineering	**Requirements Management** **Requirements Development** **Technical Solution** **Product Integration** **Verification** **Validation**
Process Management	**Organizational Process Focus** **Organizational Process Definition** **Organizational Training** **Organizational Process Performance** **Organizational Innovation and Deployment**

Project Management
Process Areas

- **There are eight Project Management Process Areas.**
  - –**Project Planning**
  - –**Project Monitoring and Control**
  - –**Supplier Agreement Management**
  - –**Integrated Project Management**
  - –**Integrated Supplier Management (SS)**
  - –**Risk Management**
  - –**Quantitative Project Management**

  - –**Integrated Teaming (IT) and IPM(IPPD) will be discussed with IPPD.**

Basic Project Management PAs
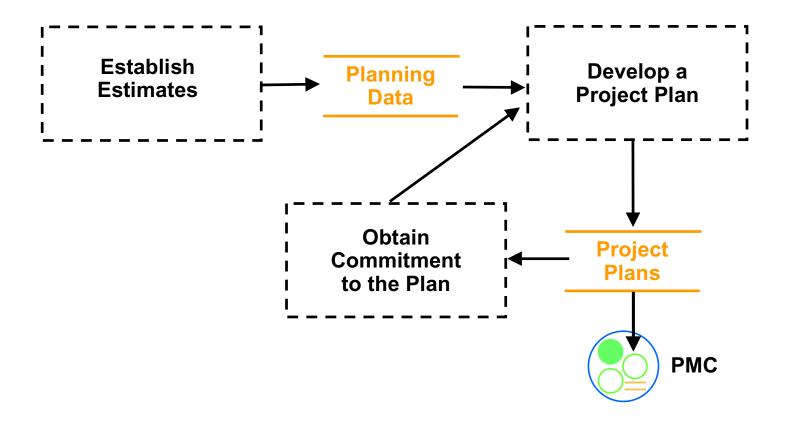
Project Planning

- **Purpose:**

- **Establish and maintain plans that define project activities.**
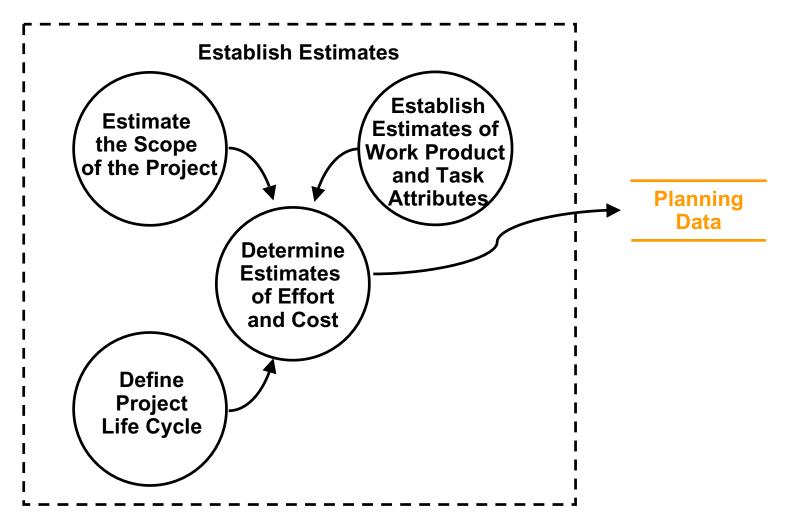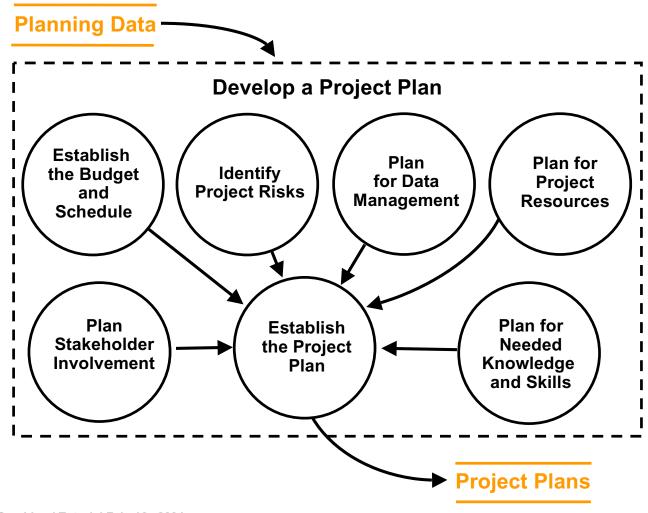
Project Planning - Context

Project Planning - Context

Establish Estimates

- Estimate the Scope of the Project
- Establish Estimates of Work Product and Task Attributes
- Determine Estimates of Effort and Cost
- Define Project Life Cycle

Planning Data

Project Planning - Context

Planning Data

Develop a Project Plan

- Establish the Budget and Schedule
- Identify Project Risks
- Plan for Data Management
- Plan for Project Resources
- Plan Stakeholder Involvement
- Establish the Project Plan
- Plan for Needed Knowledge and Skills

Project Plans

Project Planning - Context

Project Monitoring and Control

- **Purpose:**

- **Provide understanding into the project's progress so that appropriate corrective actions can be taken when the project's performance deviates significantly from the plan.**

Project Monitoring and Control - Context

CMMI

Monitor Project Against Plans

- Monitor Project Planning Parameters
- Monitor Project Risks
- Monitor Stakeholder Involvement
- Conduct Milestone Reviews
- Monitor Commitments
- Monitor Data Management
- Conduct progress Reviews

Manage Corrective Actions to Closure

- Analyze Issues
- Take Corrective Actions
- Manage Corrective Actions

PP

Project Plans
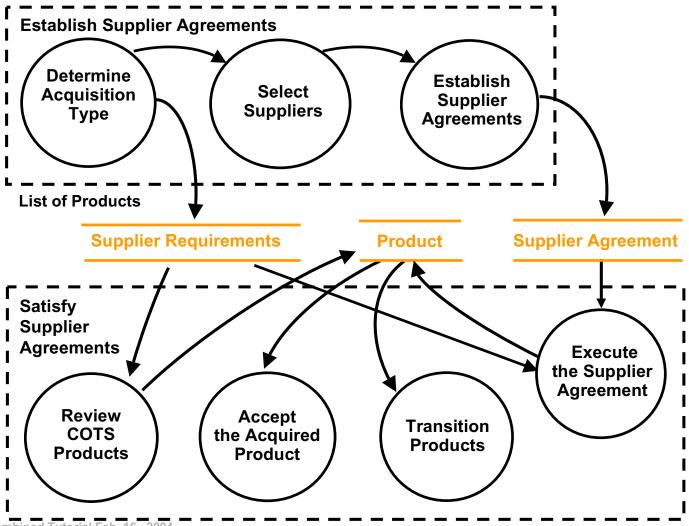
Supplier Agreement Management

- **Purpose:**

- **Manage the acquisition of products from suppliers for which there exists a formal agreement.**

Supplier Agreement Management Context

Establish Supplier Agreements

- Determine Acquisition Type
- Select Suppliers
- Establish Supplier Agreements

List of Products

- Supplier Requirements
- Product
- Supplier Agreement

Satisfy Supplier Agreements
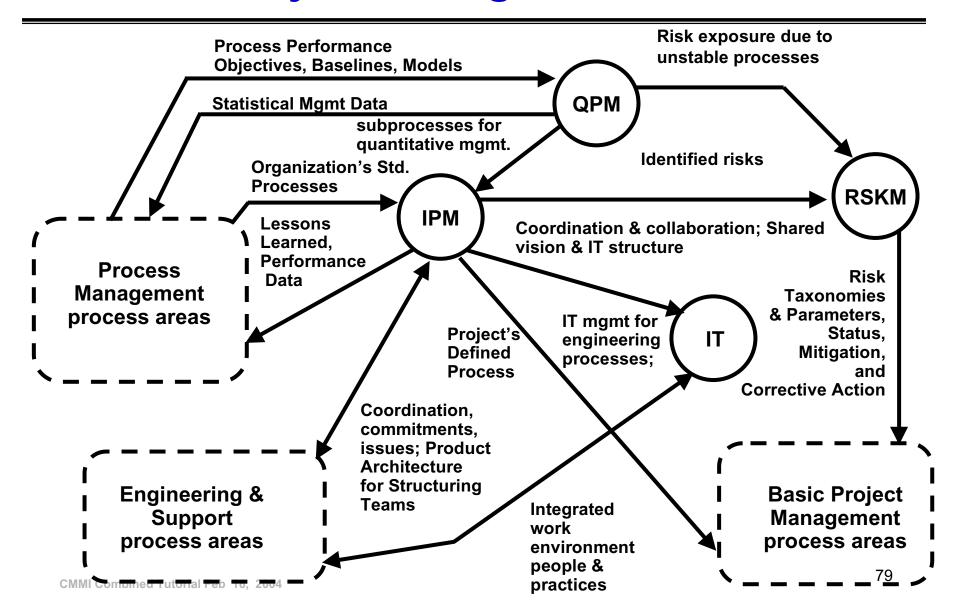
- Review COTS Products
- Accept the Acquired Product
- Transition Products
- Execute the Supplier Agreement

Advanced Project Management PAs

Process Performance Objectives, Baselines, Models

Risk exposure due to unstable processes

Statistical Mgmt Data

subprocesses for quantitative mgmt.

QPM

Organization's Std. Processes

Identified risks

IPM

RSKM

Lessons Learned, Performance Data

Coordination & collaboration; Shared vision & IT structure

Process Management process areas

Risk Taxonomies & Parameters, Status, Mitigation, and Corrective Action

Project's Defined Process

IT mgmt for engineering processes;

IT

Coordination, commitments, issues; Product Architecture for Structuring Teams

Engineering & Support process areas

Integrated work environment people & practices

Basic Project Management process areas

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Integrated Project Management

- **Purpose:**

- **Establish and manage the project and the involvement of the relevant stakeholders according to an integrated and defined process that is tailored from the organization's set of standard processes.**

Integrated Project Management - Context

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Integrated Supplier Management
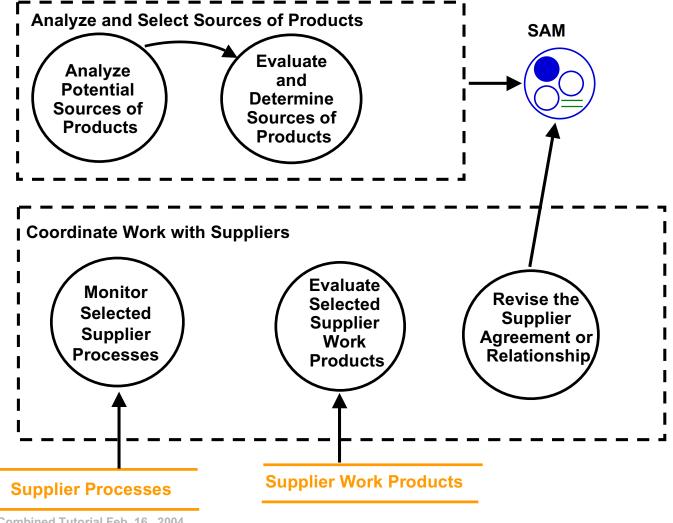
- **Purpose:**

- **Proactively identify sources of products that may be used to satisfy the project's requirements and to manage selected suppliers while maintaining a cooperative project-supplier relationship.**

Integrated Supplier Management - Context

Analyze and Select Sources of Products

SAM

Analyze Potential Sources of Products

Evaluate and Determine Sources of Products

Coordinate Work with Suppliers

Monitor Selected Supplier Processes

Evaluate Selected Supplier Work Products

Revise the Supplier Agreement or Relationship

Supplier Processes

Supplier Work Products
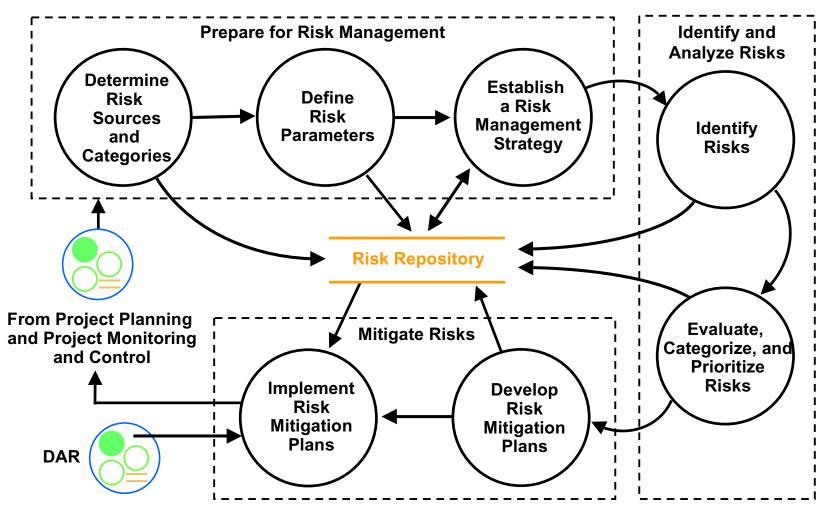
Risk Management

- **Purpose:**

- **Identify potential problems before they occur, so that risk handling activities may be planned and invoked as needed across the life of the product or project to mitigate adverse impacts on achieving objectives.**

Risk Management - Context

Prepare for Risk Management

Determine Risk Sources and Categories → Define Risk Parameters → Establish a Risk Management Strategy

Identify and Analyze Risks

Identify Risks

Risk Repository

From Project Planning and Project Monitoring and Control

Mitigate Risks

Implement Risk Mitigation Plans ← Develop Risk Mitigation Plans ← Evaluate, Categorize, and Prioritize Risks

DAR
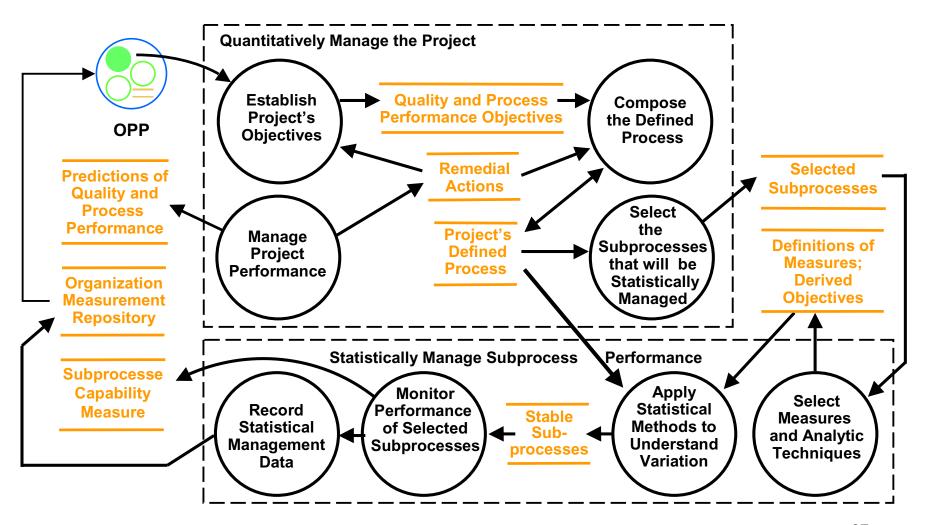
Quantitative Project Management

- **Purpose:**

- **Quantitatively manage the project's defined process to achieve the project's established quality and process-performance objectives.**

Quantitative Project Management - Context

CMMI

Quantitatively Manage the Project

OPP

Establish Project's Objectives

Quality and Process Performance Objectives

Compose the Defined Process

Predictions of Quality and Process Performance

Remedial Actions

Manage Project Performance

Project's Defined Process

Select the Subprocesses that will be Statistically Managed

Selected Subprocesses

Organization Measurement Repository

Definitions of Measures; Derived Objectives

Subprocesse Capability Measure

Statistically Manage Subprocess Performance

Record Statistical Management Data

Monitor Performance of Selected Subprocesses

Stable Sub-processes

Apply Statistical Methods to Understand Variation

Select Measures and Analytic Techniques

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Summary

- **Project Planning**

- **Project Monitoring and Control**

- **Supplier Agreement Management**

- **Risk Management**

- **Integrated Project Management**

- **Integrated Supplier Management (SS)**

- **Quantitative Project Management**

Special Note: Integrated Teaming (IT) and IPM(IPPD) will be discussed with IPPD.

Support Process Areas

There are six Support Process Areas:
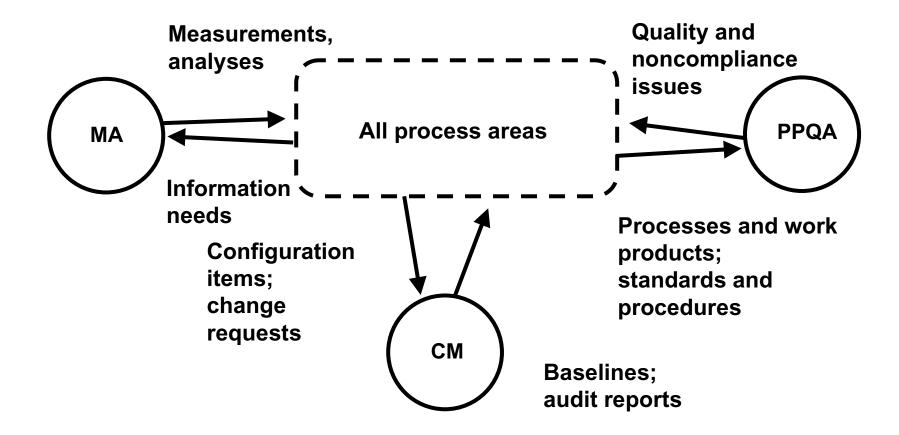
- **Configuration Management**

- **Process and Product Quality Assurance**

- **Measurement and Analysis**

- **Causal Analysis and Resolution**

- **Decision Analysis and Resolution**

- **Organizational Environment for Integration will be discussed with IPPD.**

Understanding Support Processes

- **Support process areas cover the practices that support product development, maintenance, and acquisition.**

- **They provide essential processes used by all the CMMI process areas, and are typically used in the context of performing other processes.**

Basic Support Process Areas

Measurements, analyses

Quality and noncompliance issues

MA

All process areas

PPQA

Information needs

Configuration items; change requests

Processes and work products; standards and procedures

CM

Baselines; audit reports
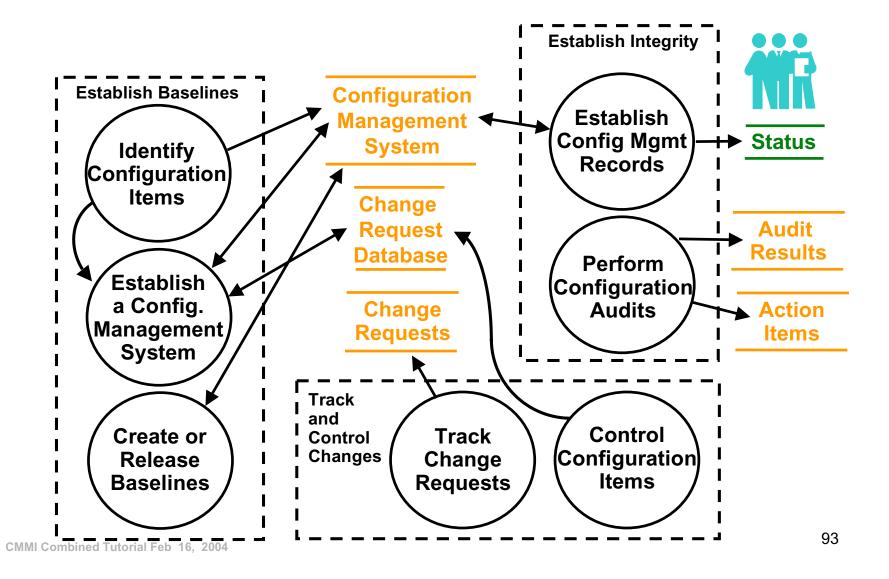
Configuration Management

- **Purpose:**

- **Establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits.**

Configuration Management - Context

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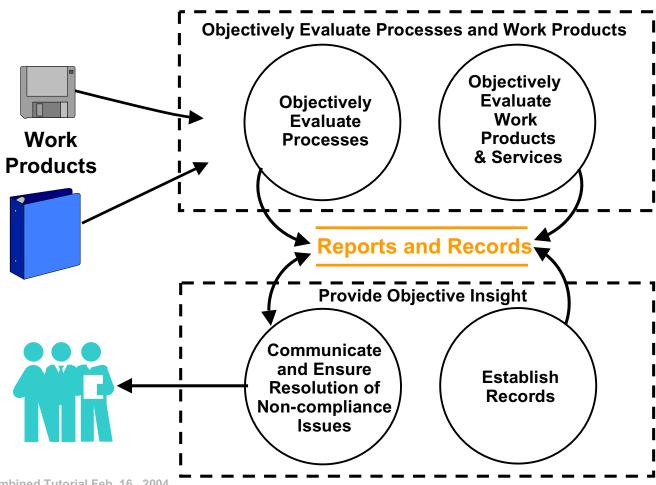
Process and Product Quality Assurance

- **Purpose:**

- **Provide staff and management with objective insight into processes and associated work products.**

Process and Product Quality Assurance - Context

Objectively Evaluate Processes and Work Products

Work Products

Objectively Evaluate Processes

Objectively Evaluate Work Products & Services

Reports and Records

Provide Objective Insight

Communicate and Ensure Resolution of Non-compliance Issues

Establish Records
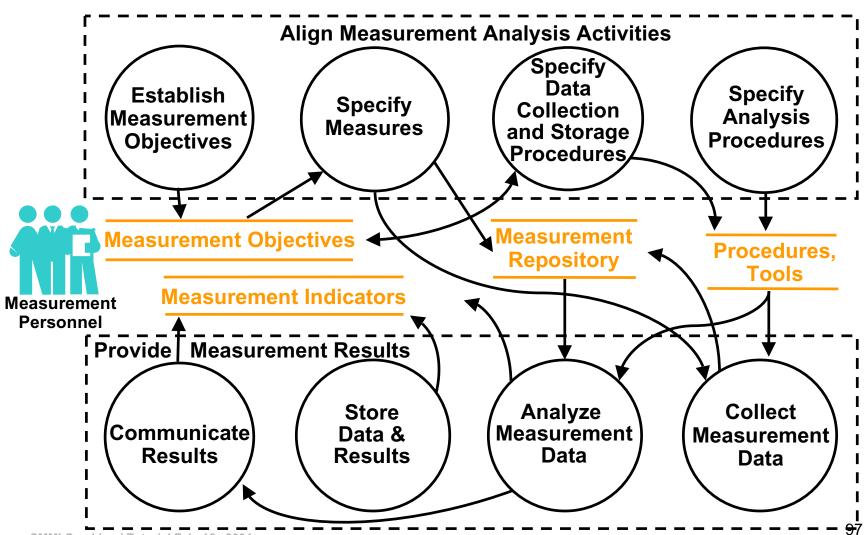
Measurement and Analysis
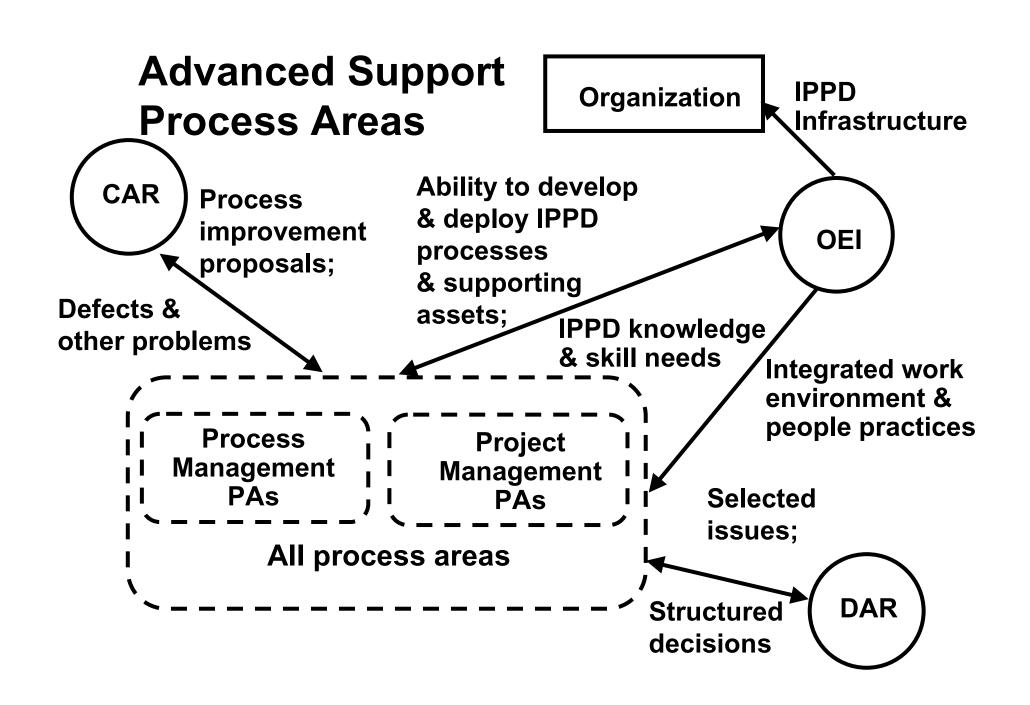
- **Purpose:**

- **Develop and sustain a measurement capability that is used to support management information needs.**

Measurement & Analysis - Context

Advanced Support Process Areas

Organization

IPPD Infrastructure

CAR

Process improvement proposals;

Defects & other problems

Ability to develop & deploy IPPD processes & supporting assets;

OEI

IPPD knowledge & skill needs

Integrated work environment & people practices

Process Management PAs

Project Management PAs

All process areas

Selected issues;

DAR

Structured decisions
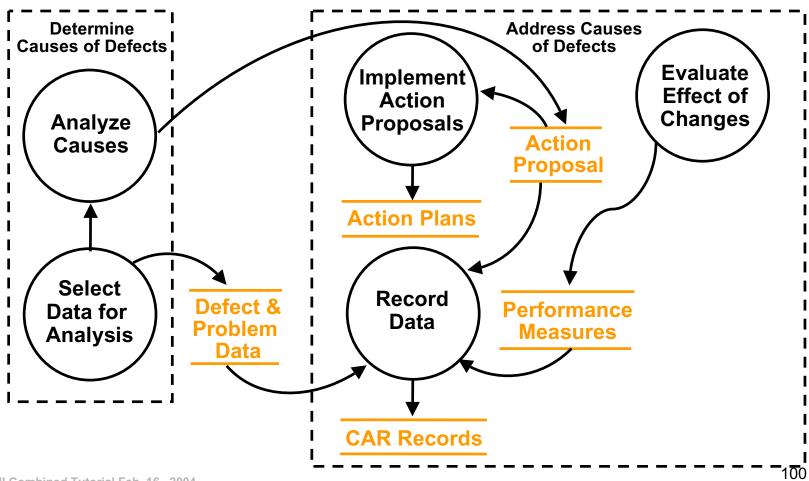
Causal Analysis and Resolution

- **Purpose:**

- **Identify causes of defects and other problems and take action to prevent them from occurring in the future.**

Causal Analysis and Resolution - Context

CMMI

Determine Causes of Defects

Analyze Causes

Select Data for Analysis

Defect & Problem Data

Address Causes of Defects

Implement Action Proposals

Action Proposal

Evaluate Effect of Changes

Action Plans

Record Data

Performance Measures

CAR Records

Decision Analysis and Resolution

- **Purpose:**

- **Analyze possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.**
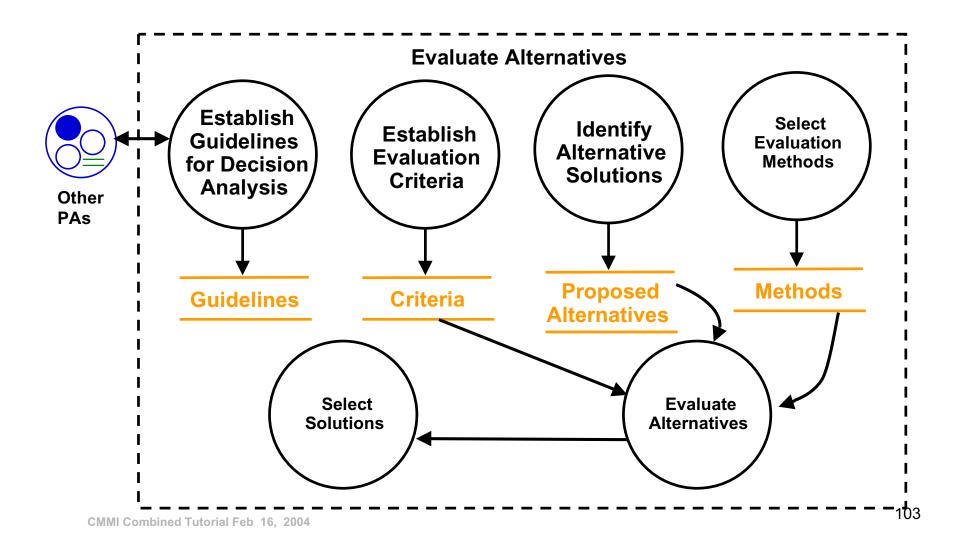
Decision Analysis and Resolution

- **Applicability:**

- **The project should document guidelines for when a structured decision analysis process is to be used.**

- **DAR should be applied where significant technical, cost, or schedule risks evolve.**

Decision Analysis and Resolution -Context
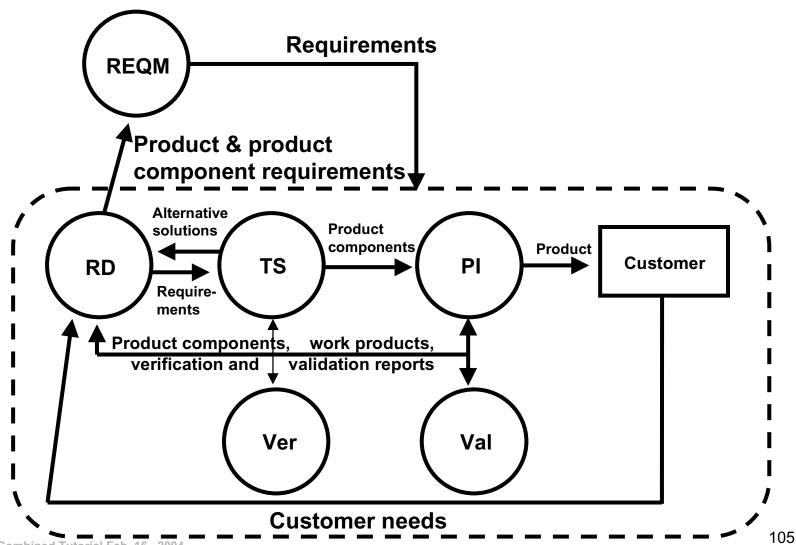
Engineering Process Areas

- **There are six Engineering Process Areas.**

  - **Requirements Management**

  - **Requirements Development**

  - **Technical Solution**

  - **Product Integration**

  - **Verification**

  - **Validation**

Engineering Process Areas
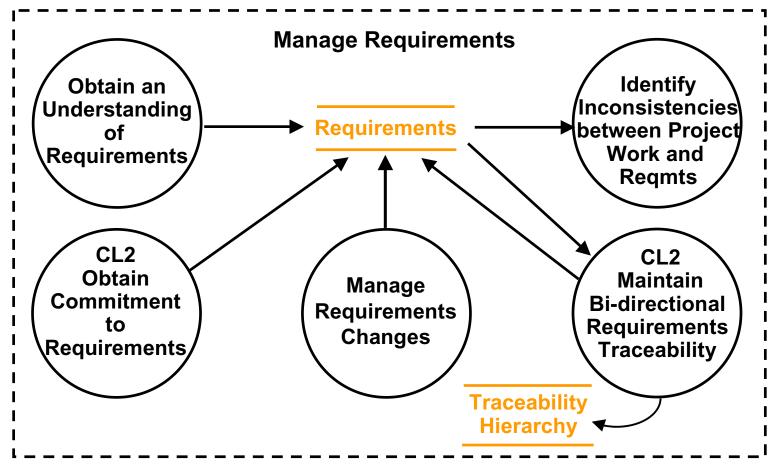
Requirements Management

- Purpose:

- Manage the requirements of the project's product and product components and identify inconsistencies between those requirements and the project's plans and work products.

Requirements Management Context

Manage Requirements

- Obtain an Understanding of Requirements
- Requirements
- Identify Inconsistencies between Project Work and Reqmts
- CL2 Obtain Commitment to Requirements
- Manage Requirements Changes
- CL2 Maintain Bi-directional Requirements Traceability
- Traceability Hierarchy
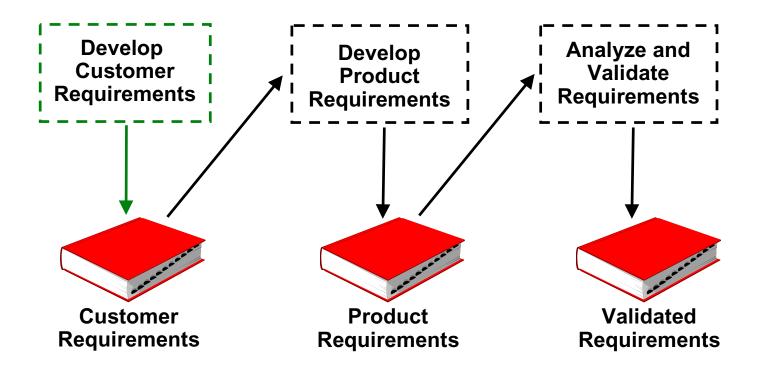
Requirements Development

- **Purpose:**

- **Produce and analyze customer, product, and product component requirements.**

Requirements Development - Context

Develop Customer Requirements → Customer Requirements

Customer Requirements → Develop Product Requirements

Develop Product Requirements → Product Requirements

Product Requirements → Analyze and Validate Requirements

Analyze and Validate Requirements → Validated Requirements

Requirements Development Context

Develop Customer Requirements

Collect Stakeholder Needs

Develop the Customer Requirements

CL2 Elicit Needs

Customer Requirements

Requirements Development Context

Develop Product Requirements

Establish Product & Product Component Requirements

Allocate Product and Product-Component Requirements

Identify Interface Requirements

Customer Requirements

Product Requirements

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Requirements Development Context

Analyze and Validate Requirements

Establish Operational Concepts & Scenarios → Establish a Definition of Required Functionality → Analyze Requirements → CL3 Analyze Requirements to Achieve Balance

Validate Requirements → CL2 Validate Requirements with Comprehensive Methods

Product Requirements

Validated Requirements

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Technical Solution

- **Purpose:**

- **Design, develop, and implement solutions to requirements. Solutions, designs and implementations encompass products, product components, and product related life-cycle processes either singly or in combinations as appropriate.**

Technical Solution - Context

Validated Requirements

Select Product-Component Solutions

Develop the Design

Implement the Product Design

Alternative Designs and Evaluation Criteria

Design Detail & Documentation

Delivered Product

Technical Solution - Context

Validated Requirements

Operational Scenarios Timeline Analysis Use Cases

DAR

Select Product Component Solutions

Develop Alternative Solutions and Selection Criteria

CL 2 Develop Detailed Solutions and Selection Criteria

CL 2 Evolve Operational Concepts & Scenarios

Select Product Component Solutions

Alternative Solutions Selection Criteria New Technology Evaluations

Selection Decisions Compliance w/ Reqmts

Technical Solution - Context

CMMI

Selection Criteria
Make/Buy Analysis

Develop the Design

Design the Product or Product Component

Establish a Tech Data Package

Establish Interface Descriptions

Perform Make, Buy, or Reuse Analyses

Tech Data Package

I/F Design Documentation
I/F Specification
I/F Control Documents

Design Methods
Design Tools
Design Processes

CL 3 Design Interfaces Using Criteria

Technical Solution - Context

Implement the Product Design

Implement The Design

Develop Product Support Documentation

Parts Fabricated
Software Coded
Data Documented
Processes Documented
Facilities Constructed

Training Manuals
Users Manual
Operator's Manual
Maintenance Manual
On-line Help
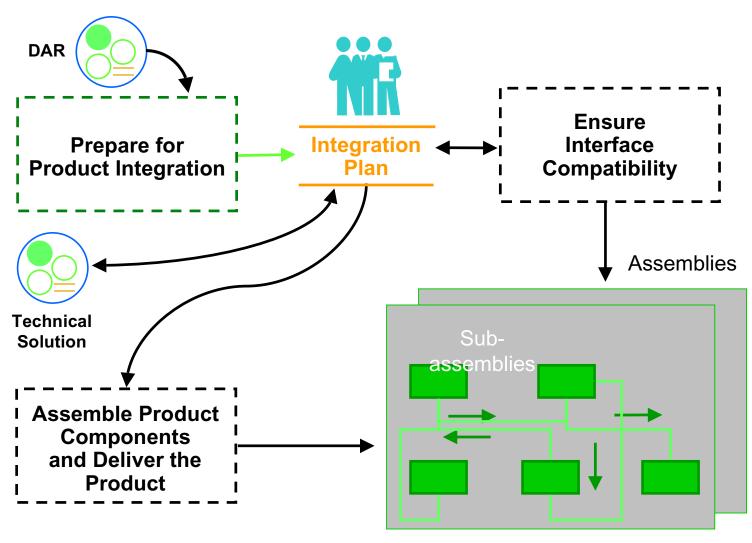
Product Integration

- **Purpose:**
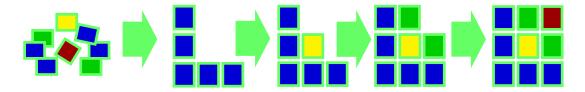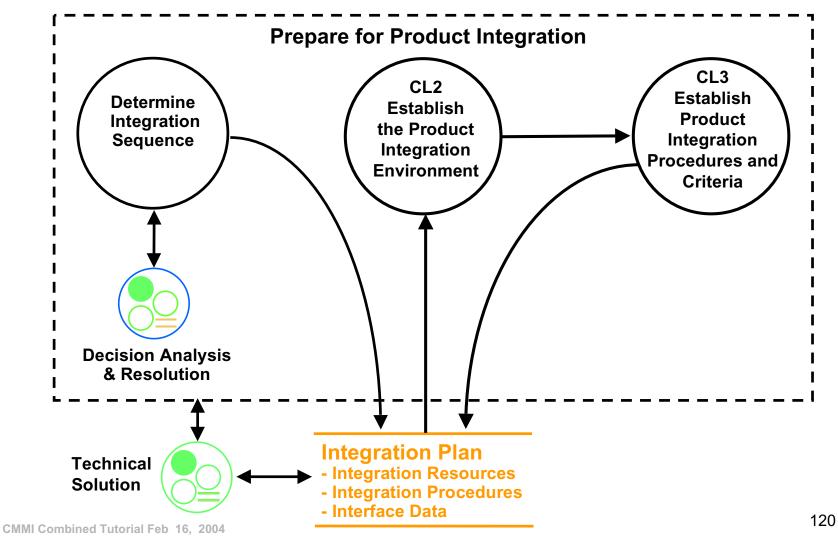
- **Assemble the product from the product components, ensure the product, as integrated, functions properly and deliver the product.**

Product Integration - Context

CMMI

DAR

Prepare for Product Integration

Integration Plan

Ensure Interface Compatibility

Technical Solution

Assemblies

Assemble Product Components and Deliver the Product

Sub-assemblies

Product Integration - Context

Prepare for Product Integration

Determine Integration Sequence

CL2 Establish the Product Integration Environment

CL3 Establish Product Integration Procedures and Criteria

Decision Analysis & Resolution

Technical Solution

Integration Plan
- **Integration Resources**
- **Integration Procedures**
- **Interface Data**

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Product Integration - Context

Ensure Interface Compatibility

Review Interface Descriptions for Completeness

Manage Interfaces

Technical Solution

Integration Plan
- Integration Resources
- Integration Procedures
- Interface Data

Product Integration - Context

Assemble Product Components and Deliver Product

Assemble Product Components

Package And Deliver the Product or Product Component

Confirm Readiness of Components for Integration

Evaluate Assembled Product Components

Technical Solution

Integration Plan
- **Integration Resources**
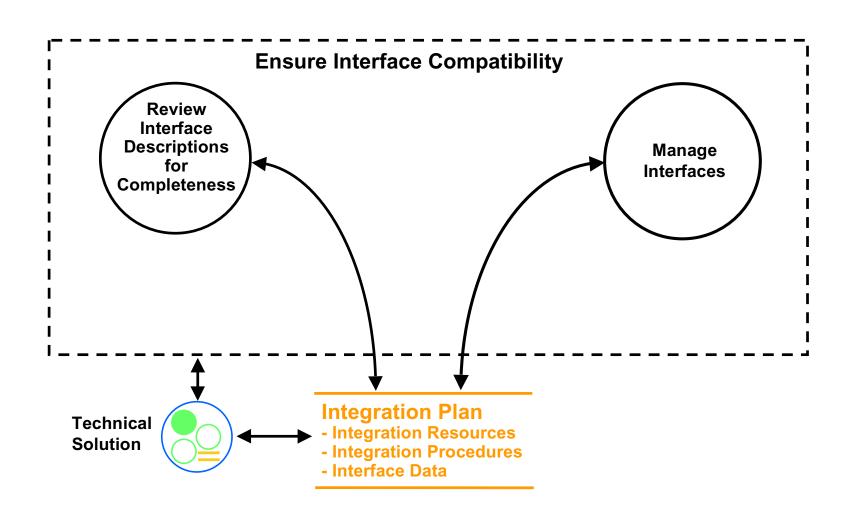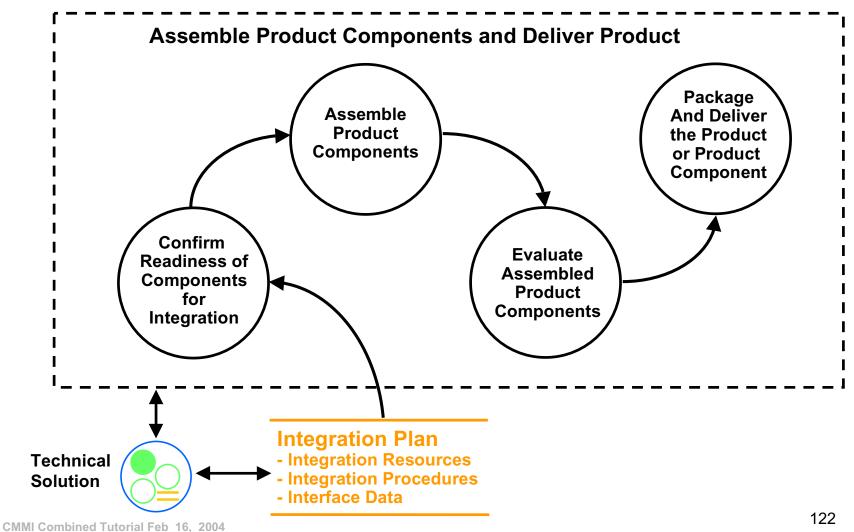- **Integration Procedures**
- **Interface Data**

Verification versus Validation

- **Verification**
  - Did you build the *product right*?
  - That is, did you meet the requirements specification?

- **Validation**
  - Did you build the *right product*?
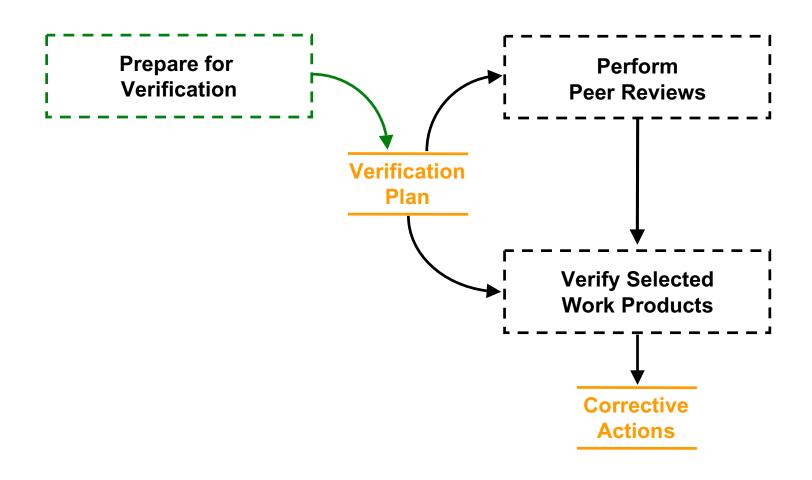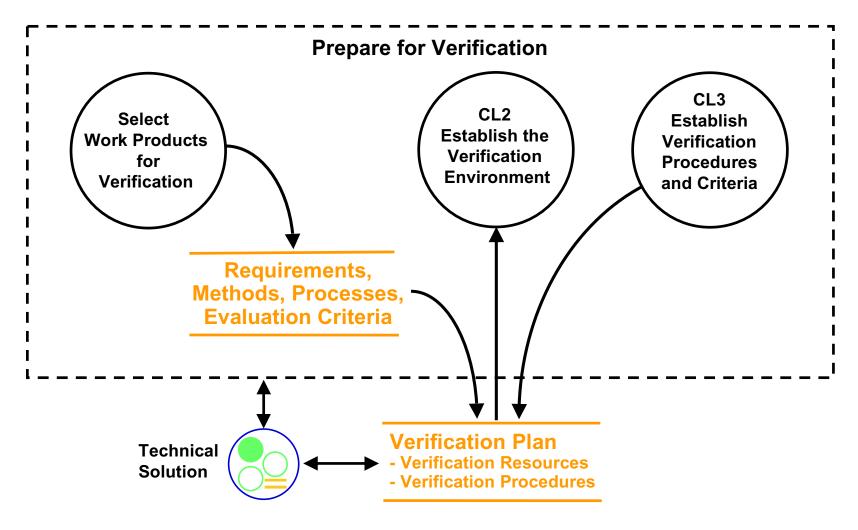 - That is, did you meet the operational need?

Verification

- **Purpose:**

- **Ensure that selected work products meet their specified requirements.**
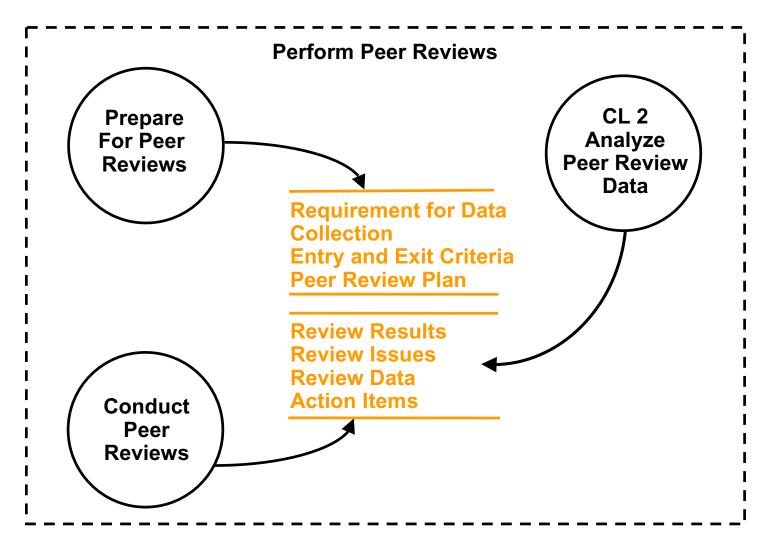
Verification - Context

```
┌─────────────────────┐                    ┌─────────────────────┐
│                     │                    │                     │
│    Prepare for      │                    │     Perform         │
│    Verification     │                    │   Peer Reviews      │
│                     │                    │                     │
└─────────────────────┘                    └─────────────────────┘

                    Verification
                       Plan

                                           ┌─────────────────────┐
                                           │                     │
                                           │   Verify Selected   │
                                           │   Work Products     │
                                           │                     │
                                           └─────────────────────┘

                                               Corrective
                                                Actions
```

Verification - Context

Prepare for Verification

Select Work Products for Verification

CL2 Establish the Verification Environment

CL3 Establish Verification Procedures and Criteria

Requirements, Methods, Processes, Evaluation Criteria

Technical Solution

Verification Plan
- Verification Resources
- Verification Procedures

Verification - Context

Perform Peer Reviews

Prepare For Peer Reviews

CL 2 Analyze Peer Review Data

Requirement for Data Collection
Entry and Exit Criteria
Peer Review Plan

Review Results
Review Issues
Review Data
Action Items

Conduct Peer Reviews

Verification - Context

Verify Selected Work Products

Perform Verification

Verification Results
Deficiencies
Verification Data
Corrective Actions

CL2 Analyze Verification Results and Identify Corrective Actions

Validation

- **Purpose:**

- **Demonstrate that a product or product component fulfills its intended use when placed in its intended environment.**

Validation - Context

- Customer Requirements
- Product Requirements
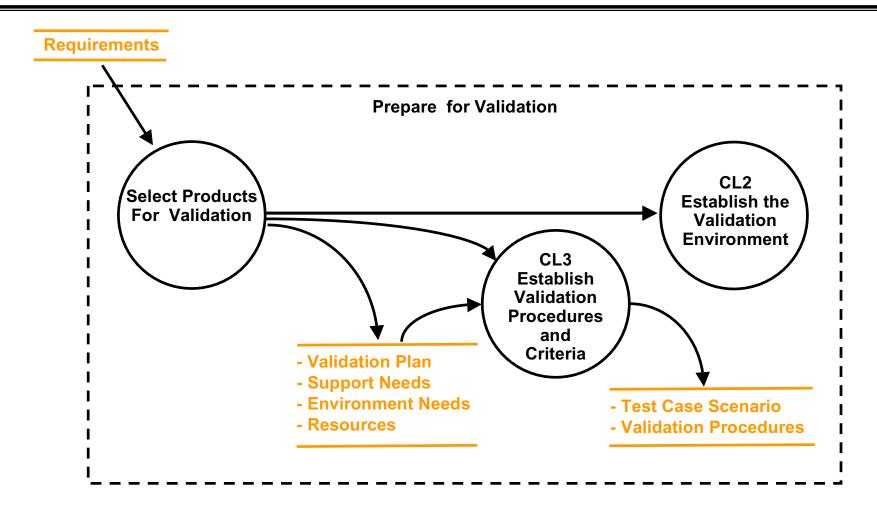- Products
- Validation Requirements

Prepare
for Validation

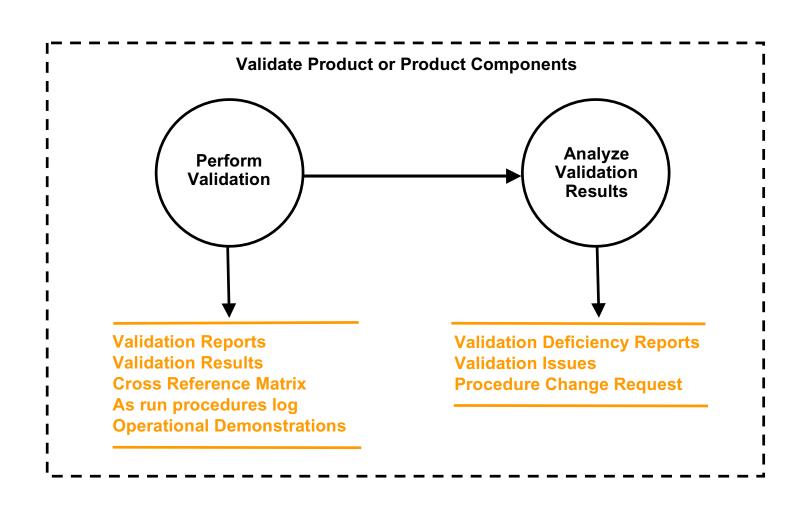Validate Product or
Product Components

- Requirements Validation Plan
- Product Validation Plan
- Process and Support Needs

- Conformance
- Deficiencies

Validation - Context

Requirements

Prepare for Validation

Select Products For Validation

CL2 Establish the Validation Environment

CL3 Establish Validation Procedures and Criteria

- Validation Plan
- Support Needs
- Environment Needs
- Resources

- Test Case Scenario
- Validation Procedures

Validation - Context

Validate Product or Product Components

Perform Validation → **Analyze Validation Results**

Validation Reports
Validation Results
Cross Reference Matrix
As run procedures log
Operational Demonstrations

Validation Deficiency Reports
Validation Issues
Procedure Change Request

Process Management Process Areas

- **There are six Process Management Process Areas:**
  - –**Organizational Process Focus**
  - –**Organizational Process Definition**
  - –**Organizational Training**
  - –**Organizational Process Performance**
  - –**Organizational Innovation and Deployment**
  - –**Organizational Environment for Integration will be covered with IPPD**

Understanding Process Management Process Areas

- The process management PAs apply across the *organization* as a whole and provide details that support the Capability Level 3 Generic Goal.

- For selected PAs, the organization has standard processes, which individual projects tailor to their needs.

Understanding Process Management Process Areas
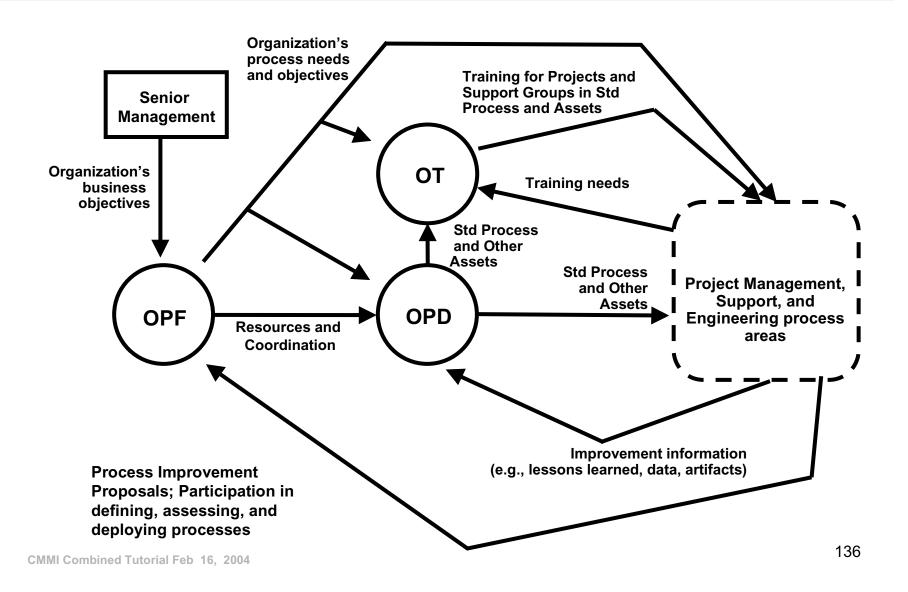
- Process Management PAs can capitalize on *project level* stability provided by PAs that are institutionalized at CL 2.

- (i.e., policy, planning, resources, responsibility, training, performing the process, managing configurations, monitoring and controlling, objective verification, management review)
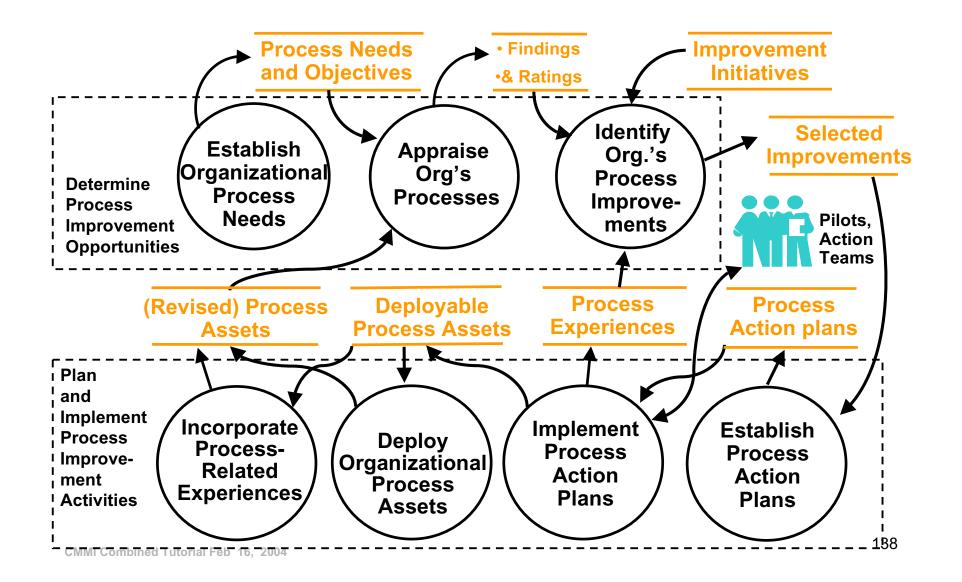
Basic Process Management PAs

Senior Management

Organization's business objectives

Organization's process needs and objectives

Training for Projects and Support Groups in Std Process and Assets

OT

Training needs

OPF

Resources and Coordination

Std Process and Other Assets

OPD

Std Process and Other Assets

Project Management, Support, and Engineering process areas

Process Improvement Proposals; Participation in defining, assessing, and deploying processes

Improvement information (e.g., lessons learned, data, artifacts)

Organizational Process Focus

- **Purpose:**

- **Plan and implement organizational process improvement based on a thorough understanding of the current strengths and weaknesses of the organization's processes and process assets.**

Organizational Process Focus
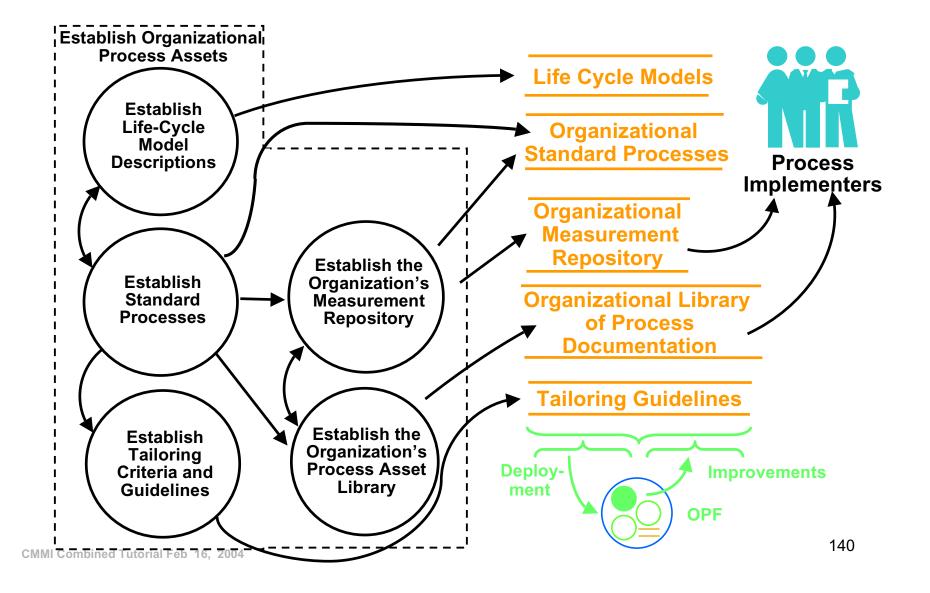## - Context

CMMI

Process Needs and Objectives

• **Findings**
• **& Ratings**

Improvement Initiatives

Selected Improvements

Determine Process Improvement Opportunities

(Establish Organizational Process Needs)

(Appraise Org's Processes)

(Identify Org.'s Process Improve-ments)

Pilots, Action Teams

(Revised) Process Assets

Deployable Process Assets

Process Experiences

Process Action plans

Plan and Implement Process Improve-ment Activities

(Incorporate Process-Related Experiences)

(Deploy Organizational Process Assets)

(Implement Process Action Plans)

(Establish Process Action Plans)

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Organizational Process Definition

- **Purpose:**

- **Establish and maintain a usable set of organizational process assets.**

Organizational Process Definition - Context
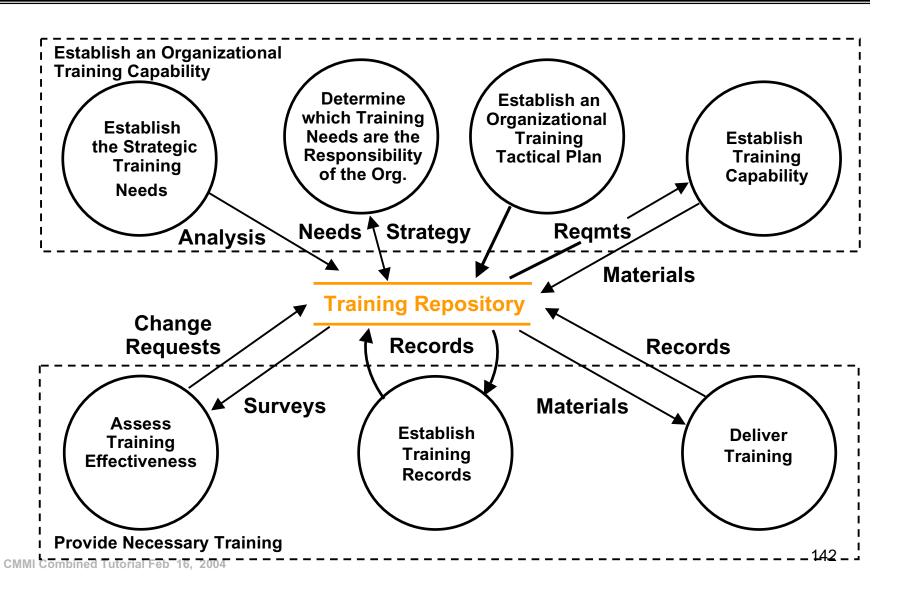
Organizational Training

- •Purpose:

- •Develop the skills and knowledge of people so they can perform their roles effectively and efficiently.
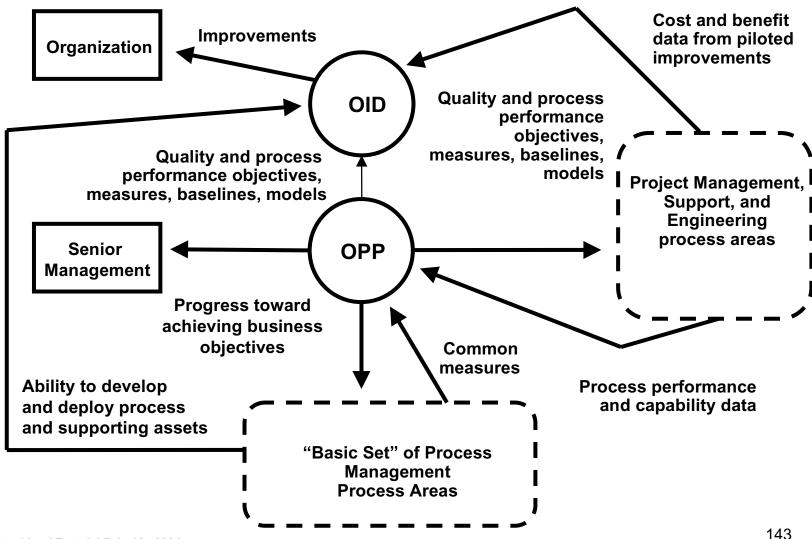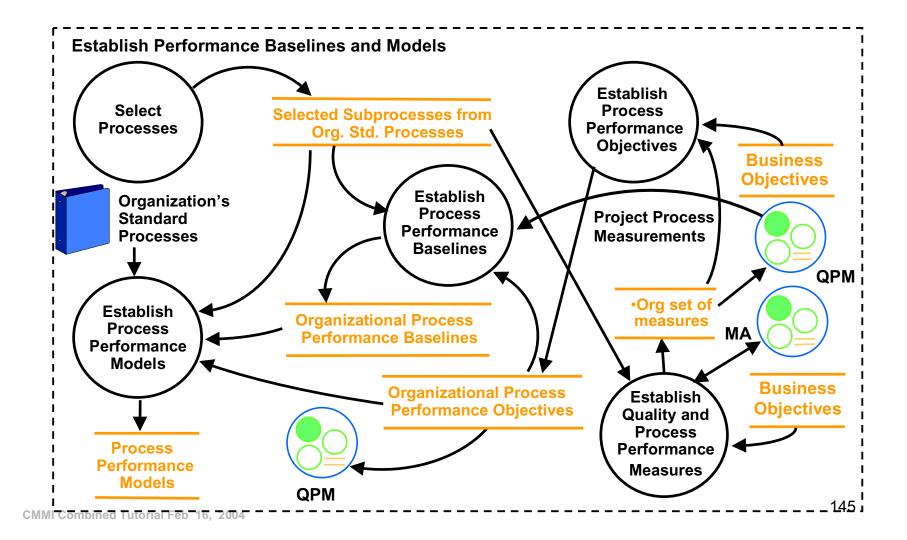
Organizational Training - Context

Establish an Organizational Training Capability

- Establish the Strategic Training Needs
- Determine which Training Needs are the Responsibility of the Org.
- Establish an Organizational Training Tactical Plan
- Establish Training Capability

Analysis   Needs   Strategy   Reqmts

Materials

Training Repository

Change Requests   Records   Records

Provide Necessary Training

- Assess Training Effectiveness
- Establish Training Records
- Deliver Training

Surveys   Materials

Advanced Process Management Process Areas

Organization

Improvements

OID

Cost and benefit data from piloted improvements

Quality and process performance objectives, measures, baselines, models

Quality and process performance objectives, measures, baselines, models

Project Management, Support, and Engineering process areas

Senior Management

OPP

Progress toward achieving business objectives

Ability to develop and deploy process and supporting assets

Common measures

Process performance and capability data

"Basic Set" of Process Management Process Areas

Organizational Process Performance

- Purpose:

- Establish and maintain a quantitative understanding of the performance of the organization's set of standard processes in support of quality and process-performance objectives, and to provide the process performance data, baselines, and models to quantitatively manage the organization's projects.

Organizational Process Performance - Context

Establish Performance Baselines and Models

- Select Processes
- Organization's Standard Processes
- Selected Subprocesses from Org. Std. Processes
- Establish Process Performance Baselines
- Establish Process Performance Objectives
- Business Objectives
- Project Process Measurements
- Establish Process Performance Models
- Organizational Process Performance Baselines
- Process Performance Models
- Organizational Process Performance Objectives
- •Org set of measures
- MA
- QPM
- Establish Quality and Process Performance Measures
- Business Objectives

Organizational Innovation and Deployment

- **Purpose:**

- **Select and deploy incremental and innovative improvements that measurably improve the organization's processes and technologies. The improvements support the organization's quality and process-performance objectives as derived from the organization's business objectives.**

Organizational Innovation and Deployment - Context

CMMI

Collect and Analyze Improvement Proposals

Identify and Analyze Innovations

Pilot Improvements

Select Improvements for Deployment

Measurement Results

Improvement Proposals and Analysis

Improvements

Deploy Improvements

Measure Improvements Effects

Manage the Deployment

Plan the Deployment

Overview of Integrated Product and Process Development
IPPD

About IPPD

- IPPD affects all process areas.

- IPPD is *not* a discipline like SE or SW.

- Rather, it is a way of doing business.

- IPPD is employed in conjunction with the CMMI disciplines (software and systems engineering).

- Implementation of IPPD shapes how you perform the work in these disciplines.

IPPD - Definition

IPPD provides a systematic approach to product development that achieves a timely collaboration of relevant stakeholders throughout the product life cycle to better satisfy customer needs.

IPPD - Definition -2

Integration of the development of product-related processes (e.g., manufacturing, support, training, disposal) during product development is embedded in SE/SW specific practices by involving relevant stakeholders from all life cycle phases and by the concept of "work product."

Stakeholder Involvement

- **Stakeholder Involvement is guided and assured by three constructs in CMMI- SE/SW/IPPD:**

- **GP 2.7 Identify and involve the relevant stakeholders of the process as planned.**

- **PP SP 2.6-1 Plan the involvement of identified stakeholders.**

- **IPM SG 2 Collaborate and coordinate with relevant stakeholders.**

CMMI Work Product - Definition

- Any artifact produced by a process.

- This may include files, documents, parts of the product, services, processes, specifications, and invoices.

- Examples of processes as work product include a manufacturing process, a training process, and a disposal process.

- A key distinction between a work product and a product component is that a work product need not be engineered (although it may be).

IPPD in CMMI Models

- **Then, what makes IPPD different from pure SE/SW implementations?**

- **IPPD relies on integrated teams to develop the product and processes.**

- **IPPD provides an integrated work environment and the management of people to incentivize teamwork.**

- **Processes are tailored to be used by integrated teams.**

CMMI Integrated Team Definition

- **An integrated team is comprised of people**
  - with complementary skills and expertise
  - appropriate skills and advocacy
  - fully empowered to represent stakeholders
  - from all phases of the work product's life cycle

- **These people are committed to and are collectively responsible for**
  - delivering specified work products
  - through timely collaboration

Scope of IPPD

- **CMMI SE/SW/IPPD adds to CMMI-SE/SW:**

  - **Two new process areas**
    - » Organizational Environment for Integration
    - » Integrated Teaming
  - **A revised Integrated Project Management (IPPD) process area**
  - **IPPD amplifications and references**
  - **New glossary definitions and acronyms**
  - **Overview material**
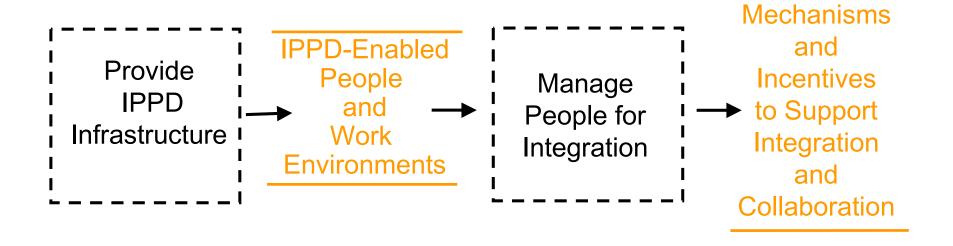
Organizational Environment for Integration (OEI)

•Purpose:

•To provide an Integrated Product and Process Development (IPPD) infrastructure and manage people for integration.
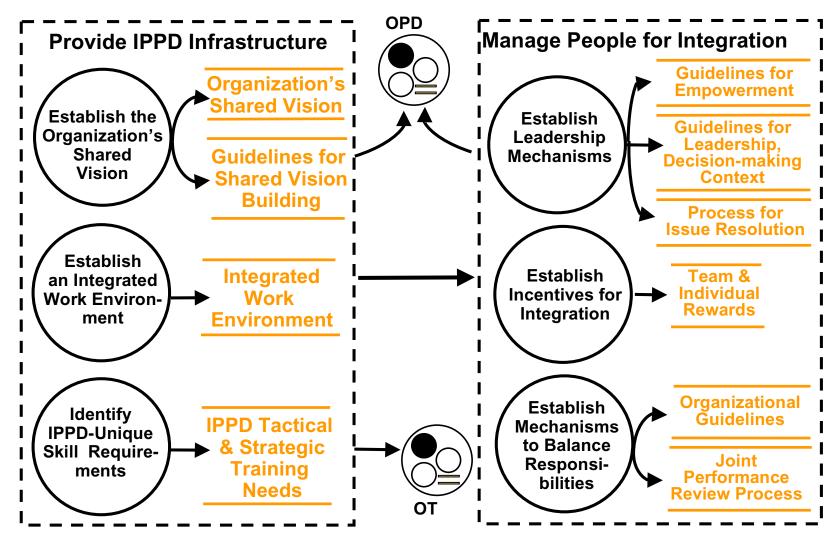
Organizational Environment
for Integration (OEI)- Context

```
┌ ─ ─ ─ ─ ─ ─ ┐          ┌ ─ ─ ─ ─ ─ ─ ┐
│             │          │             │
│   Provide   │  ──►  IPPD-Enabled  ──►  │   Manage    │  ──►  Mechanisms
│    IPPD     │         People          │  People for │         and
│Infrastructure│          and           │ Integration │      Incentives
│             │          Work           │             │      to Support
└ ─ ─ ─ ─ ─ ─ ┘       Environments       └ ─ ─ ─ ─ ─ ─ ┘      Integration
                                                                  and
                                                              Collaboration
```

Organizational Environment for Integration – Context

Provide IPPD Infrastructure

- Establish the Organization's Shared Vision → Organization's Shared Vision
- → Guidelines for Shared Vision Building
- Establish an Integrated Work Environment → Integrated Work Environment
- Identify IPPD-Unique Skill Requirements → IPPD Tactical & Strategic Training Needs

OPD

OT

Manage People for Integration

- Establish Leadership Mechanisms → Guidelines for Empowerment
- → Guidelines for Leadership, Decision-making Context
- → Process for Issue Resolution
- Establish Incentives for Integration → Team & Individual Rewards
- Establish Mechanisms to Balance Responsibilities → Organizational Guidelines
- → Joint Performance Review Process

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Integrated Project Management
For IPPD

- **Purpose:**

- **Establish and manage the project and the involvement of the relevant stakeholders according to an integrated and defined process that is tailored from the organization's set of standard processes.**

- **For Integrated Product and Process Development, Integrated Project Management also covers the establishment of a a shared vision for the project and an integrated team structure that will carry out the objectives of the project.**
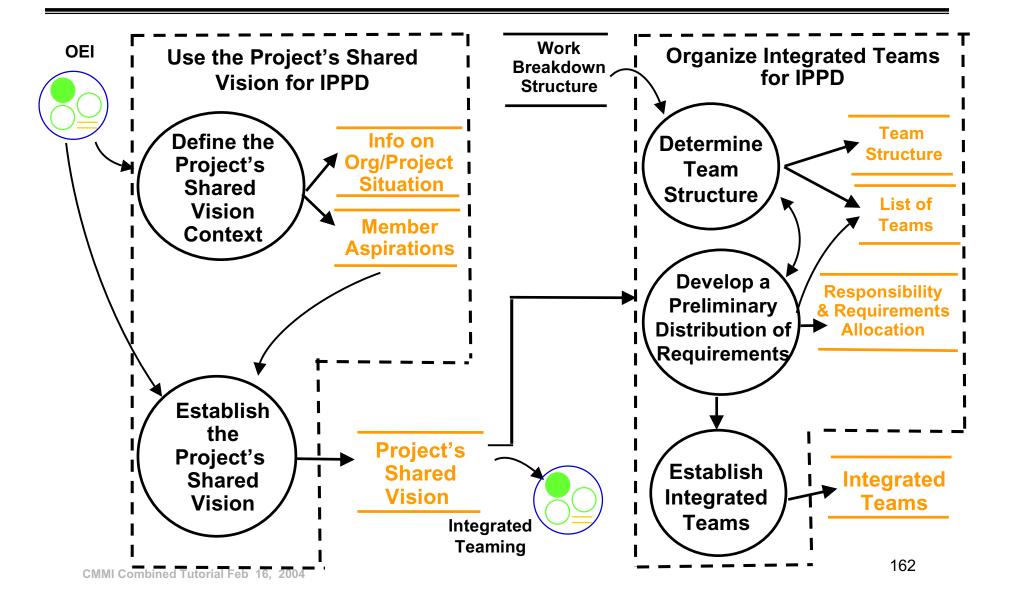
Integrated Project Management (IPPD) - Context

Product Requirements → **Use the Project's Defined Process** → **Defined Process Based Project Plan** → **Coordinate and Collaborate with Relevant Stakeholders** → **Contributions to Organization's Process Assets**

Stakeholders

Use the Project's Shared Vision for IPPD → **Project's Shared Vision** → **Organize Integrated Teams for IPPD** → **Integrated Teams**

Organizational Environment for Integration

Stakeholders

Integrated Project Management (IPPD)

OEI

Use the Project's Shared Vision for IPPD

Define the Project's Shared Vision Context

→ Info on Org/Project Situation

→ Member Aspirations

Establish the Project's Shared Vision

→ Project's Shared Vision

Integrated Teaming

Work Breakdown Structure

Organize Integrated Teams for IPPD

Determine Team Structure

→ Team Structure

→ List of Teams

Develop a Preliminary Distribution of Requirements

→ Responsibility & Requirements Allocation

Establish Integrated Teams

→ Integrated Teams

Integrated Teaming

- Purpose:

- To form and sustain an integrated team for the development of work products.

Integrated Teaming - Context

Sponsor's Objectives

Assigned Product Requirements

IPM

Establish Team Composition

Integrated Team

Govern Team Operation

OEI

Plans and Commitments

PP

Relevant Stakeholders

Integrated Teaming - Context

Establish Team Composition

Sponsors Objectives

Assigned Product Requirements

Stakeholders

Identify Team Tasks

Results Lists

Task Descriptions

Identify Knowledge and Skills

Functions, Skills, & Expertise Lists

Assign Appropriate Team Members

Integrated Team

Govern Team Operation

Establish a Shared Vision

Team's Shared Vision

Establish a Team Charter

Team Charter

Define Roles & Respon-sibilities

Assignments, & Respon-sibilities

Establish Operating Procedures

Ground Rules and Procedures

Collaborate among Interfacing Teams

Plans and Commitments

Training

"Introduction to the CMMI" Course, *Staged & Continuous (Separate Courses)*

- **Introduction course will enable the participant to**
  - Understand the importance of defined processes
  - Understand the rationale for process improvement
  - Comprehend the CMMI model
  - Identify ways of applying the CMMI model for process improvement

- **Broad audience**
  - Systems and software developers
  - Systems, Program and software managers
  - Practitioners of disciplines that support systems and software
  - Government and industry acquirers of software-intensive systems

- **Assumes one year of experience in systems and software**

- **No process improvement or Capability Maturity Model® (CMM®) experience assumed**

"Intermediate Concepts of CMMI Models" Course

- **Provides a deeper understanding of the CMMI and it's fundamental concepts.**
  - **PA's in more detail**
  - **Linking the PA's together**
  - **Interpreting the CMMI for appraisals**
  - **Application of CMMI for process improvement**

- **Required as a prerequisite to SCAMPI Lead Appraiser training and "train the trainer" course.**

Appraisal Requirements for CMMI (ARC) v1.1

- **Similar to the current CMM Appraisal Framework (CAF) V1.0**
  - **A guide to appraisal method developers**

- **Specifies the requirements for classes of appraisal methods**
  - **Class A: Full, comprehensive appraisal methods**
  - **Class B: Initial, incremental, self-appraisals**
  - **Class C: Quick-look**

- **Method developers can declare which class their method fits**

- **Implications of the desired class of appraisal**

Standard CMMI Appraisal Method for Process Improvement (SCAMPI)

- Similar to CBA IPI method

- Led by authorized Lead Appraiser

- Tailorable to organization and model scope

- Source selection appraisals or process monitoring are tailoring options of SCAMPI

- SCAMPI Method Definition Document V1.1

CMMI Lead Appraiser Program

- **Similar to existing SEI Lead Assessor and Lead Evaluator programs**
  - **Administered by SEI**

- **Will transition current SW & SE Lead Assessors or Evaluators, as well as new candidates**

- **Lead Appraiser requirements:**
  - **Introduction to CMMI Training**
  - **Appraisal team experience**
  - **Intermediate CMMI Training**
  - **SCAMPI Lead Appraiser Training**

Discovers in Use

- Appraisal time shows an excellent learning curve
  - 40% reduction in appraisal time over five Australian assessments

- "Shadow appraisals" show ease of transition
  - High maturity CBA IPI at Litton PRC
  - TSP based Level 4 CBA IPI at China Lake

- Mappings and gap analyses confirm evolutionary expansion from predecessor models
  - Government and contractors agree on CMMI's improved engineering coverage in contract monitoring

Wrap-Up

CMMI Transition Plan

Development Phase

- **Development of CMMI products**
- **Verification and validation of CMMI products**

Transition Phase

- **Approval of initial CMMI products for public release**
- **Evidence of sufficient use**
- **Transition planning to help organizations use CMMI products**

Sustainment Phase

- **Upkeep and continuous improvement of the product suite**
- **Additional evidence of adoption and use**

Pilots

| V0.2 | V1.0 | V1.1 | SW-CMM, EIA 731 phased out |
| Aug 1999 | Aug 2000 | Dec 2001 | Dec 2003 |

CMMI Schedule

- Available now
  - CMMI-SE/SW/IPPD/SS, V1.1
  - SCAMPI Method Definition Document. V1.1
  - V1.1 model and method training

- December 2003
  - Sunset period for SW-CMM, EIA/IS 731 completed (no more public courses, new lead assessors)

- January 2004
  - Acquisition "module" available

- December 2005
  - SEI acceptance of SW-CMM appraisals ends

CMMI – What is coming next?

• Emphasis through 2004 is on CMMI adoption and transition from legacy models like SW-CMM V1.1; review and analysis for V1.2

• "Communities of Practice" will be encouraged (Yahoo groups, TPWeb)

• "Technical Notes" and "Special Reports" will complement V1.1:

– Mapping CMMI with other standards and models (ISO 9001:2000)

– Managing COTS integration

– Making attribute tradeoffs in design (product line practices)

– Allowing prototypical coverage for specific interests (e.g., services [released]; acquisition [in work]; safety & security [in work]; marketing [in work]

CMMI...Re-cap

- **... Is not so different from the models with which we are familiar**

- **... Has 2 representations in a single model:**
  - **Staged**
  - **Continuous**

- **... Contains specific and generic goals that must be satisfied**

- **... Is directly related to our work:**
  - **Not everything we do is just 'software' engineering**
  - **There is a lot of systems engineering and "other"**

Appraisal Topics

→ •**Appraisal Requirements for CMMI**

•**SCAMPI V1.1 Overview**

•**SCAMPI Lead Appraiser Authorization**

•**Future Directions**

•**Data on Process Improvement**

Appraisal Requirements for CMMI

- "The Appraisal Requirements for CMMI (ARC) V1.1 defines the requirements considered essential to appraisal methods intended for use with Capability Maturity Model-Integrated (CMMI) models."

- Based on appraisal principles common to source methods

- Defines three classes of appraisal methods
  - classes reflect common usage modes of appraisal methods
  - ARC requirements are allocated to each method class so as to align with the usage mode characteristics

ARC Appraisal Principles

•Start with an appraisal reference model.

•Use a formalized appraisal process.

•Involve senior management as appraisal sponsor.

•Focus the appraisal on the sponsor's business objectives.

•Observe strict confidentiality and non-attribution of data.

•Approach the appraisal collaboratively.

•Focus on follow-on activities and decision-making based upon the appraisal results.

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Appraisal Method Classes

Characteristics	Class A	Class B	Class C
Amount of objective evidence gathered (relative)	High	Medium	Low
Ratings generated	Yes	No	No
Resource needs (relative)	High	Medium	Low
Team size (relative)	Large	Medium	Small
Appraisal Team Leader Requirements	Lead Appraiser	Lead Appraiser or person trained and experienced	Person trained and experienced

Implications

- Consider a family of appraisal methods in determining overall appraisal needs

    – fit the appraisal method to the actual need,

    – many appraisal needs can be met without maturity level or capability level ratings

- Class A methods may not be the most appropriate choice for organizations early in their process improvement cycle

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Fundamental ARC Concepts

- (Process) appraisal

- Appraisal reference model

- Organizational unit

- Instantiation

- Objective evidence

Process Appraisal

(Process) appraisal - an examination of one or more processes by a trained team of professionals using an appraisal reference model as the basis for determining strengths and weaknesses

Appraisal reference model – the CMMI model to which an appraisal team correlates implemented process activities.
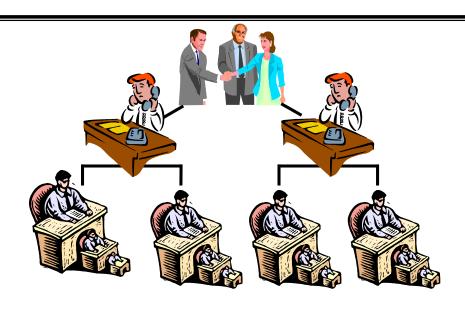
Organizational Unit (OU)

- "The part of an organization that is the subject of an appraisal (also known as the organizational scope of the appraisal). An organizational unit deploys one or more processes that have a coherent process context and operates within a coherent set of business objectives. An organizational unit is typically part of a larger organization, although in a small organization, the organizational unit may be the whole organization."
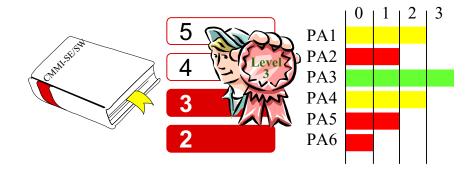
Appraisal Scope

- Defining the
- "Organizational Unit"

- Selecting CMMI^{SM} Model, Representation, and Scope

Instantiation -1

- CMMI practices are abstractions which are implemented and made real in their application and implementation by projects and organizations

- The context within which the practice is applied "governs" the implementation

- The details of the implementation as well as the context within which the practice is implemented is referred to as the instantiation (organizational or project)

"Automobile" Instantiations -2

Instantiation -3

- Sampling and instantiation in process appraisal:

- A representative sample of the practice instantiations (within the organizational unit) is identified,

- The implementation of the practice is reviewed for each member of the sample,

- The extent to which the practice is implemented (as aggregated across the sample) is taken to be a proxy for the extent to which the practice is implemented in the organizational unit.

Objective Evidence

• "Qualitative or quantitative information, records, or statements of fact pertaining to the characteristics of an item or service or to the existence and implementation of a process element, which are based on observation, measurement, or test and are verifiable."

• [Adapted from ISO 10011:1994].

• CMMI Appraisal methods are based on the consideration of objective evidence as the basis for formulation of weaknesses, strengths and ratings.

Data Collection

Instruments

Interviews

Documents

Presentations

Sources of Objective Evidence

- **Instruments**
  - Organizational assets reflecting evidence of implementation of model practices (e.g., mapping tables)
  - Questionnaires

- **Interviews**
  - Standard structured interviews; on-call interviews; follow-up interviews
  - Exploratory or focused questions targeted at manager, practitioners and/or users

- **Presentations**
  - Briefings, demonstrations

- **Documents**
  - Hardcopy, softcopy, hyperlinks

Data Collection and Recording

- **Team member notes**
  - Tagged to model and data collection sources

- **Observations**
  - Inventory of objective evidence for implementation of each model practice
  - Weaknesses (where applicable); note that strengths have a different connotation ("above and beyond") and are less relevant to determinations of practice implementation

- **Findings**
  - Aggregation of weaknesses

CMMI Appraisal Premises

- **Goal achievement is a function of the extent to which the corresponding practices are present in the planned and implemented processes of the organization.**

- **Practice implementation at the organizational unit level is a function of the degree of practice implementation at the instantiation level (e.g., projects)**

- **The aggregate of objective evidence available to the appraisal team is used as the basis for determination of practice implementation.**

- **Appraisal teams are obligated to seek and consider objective evidence of multiple types in determining the extent of practice implementation.**

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What is Practice Implementation Verification?

•Verifying practice implementation means the substantiation of practice implementation based on the review of objective evidence.

•For example:

– one might inquire as to whether a (project-specific) practice is implemented within a project, or

– one might inquire as to whether a (organization-specific) practice is implemented within an organization.

What are practice implementation indicators?

- *The fundamental idea of practice implementation indicators (PIIs) is quite simple and broadly applicable to any practice or activity; it is based on the presumption that the conduct of an activity or the implementation of a practice will result in "footprints" which are attributable to the activity or practice.*

Example: Balancing a Checkbook

•If one balances one's checkbook at the end of the month then there are several potential ways to confirm that this activity has indeed taken place:

- – the person who engaged in the checkbook balancing activity can affirm that this activity was conducted,

- – there will likely be a mark in the checkbook for each check or transaction which matches with a corresponding entry in the bank's statement,

- – there will likely be a mark on the bank's statement for each check or transaction which matches with a corresponding entry in the checkbook,

- – additional artifacts could be identified.

Indicators

- Things that provide a useful and reliable way of predicting that something else is present or true.

- E.g. the fuel gauge in your automobile.

- Pros:
  - Can highly simplify repetitive and costly operations
  - Can be great time savers

- Cons:
  - Can be misleading
  - Can be wrong

Indicators in CMMI

•In CMMI, practice implementation indicators (PIIs) refer to the "footprints" that are the necessary or incidental consequence of practice implementation.

•PIIs include artifacts as well as information gathered from interviews with managers and practitioners.

Practice Implementation Indicator Types

- **Direct Artifacts**
  - **Tangible outputs resulting directly from implementation of a practice (e.g., Typical Work Products)**

- **Indirect Artifacts**
  - **Artifacts that are a side-effect or indicative of performing a practice (e.g., meeting minutes, reviews, logs, reports)**

- **Affirmations**
  - **Oral or written statements confirming or supporting implementation of the practice**
    (e.g, interviews, questionnaires)

PII-based Process Appraisal

- PII-based process appraisal uses practice implementation indicators as the focus for verification of practice implementation.

- This is in contrast to an observation-based approach that relies on the crafting of observations that pertain to model implementation strengths or weaknesses (CBA IPI and SCAMPI V1.0 are examples of observation-based approaches.)

Example – Indicators of Practice Implementation

PP SP1.1-1:

Indirect artifacts:
-Meeting minutes,
-Team charter,
-WBS development notes

Primary artifacts:
-top-level WBS
-task descriptions
-work package
 descriptions

Establish

a top-level work breakdown structure (WBS)

to estimate the scope of the project.

Affirmations:
- "I worked on the WBS team"
- "We used the WBS"

Direct (type A PIIs)

- The tangible outputs resulting directly from implementation of a specific or generic practice.

- An integral part of verifying practice implementation.

- May be explicitly stated or implied by the practice statement or associated informative material.

Indirect (type B PIIs)

• Artifacts that are a consequence of performing a specific or generic practice or that substantiate its implementation, but which are not the purpose for which the practice is performed.

• This indicator type is especially useful when there may be doubts about whether the intent of the practice has been met; e.g., a artifact exists but there is no indication of where it came from, who worked to develop it, or how it is used.

Affirmation (type C PIIs)

• Oral or written statements confirming or supporting implementation of a specific or generic practice.

• These are usually provided by the implementers of the practice and/or internal or external customers, but may also include other stakeholders (e.g., managers, suppliers).

Aggregation Paradigm

- **Capability level and/or maturity level ratings**

- **Goal satisfaction**

- **Practice implementation (OU level)**

- **Practice implementation (practice instantiation level)**

Discipline Model (CMMI SE/SW)

- In making inferences about the extent to which practices are or are not in place (e.g. implemented), appraisers are expected to draw upon the entire model document as the basis for their decisions.

- Examples:
    - Glossary definitions
    - Front matter
    - Sub-practices
    - Related process areas

Tutorial Topics

- Appraisal Requirements for CMMI

- SCAMPI V1.1 Overview

- SCAMPI Lead Appraiser Authorization

- Future Directions

- Data on Process Improvement

Standard CMMI Appraisal Method for Process Improvement (SCAMPI)

- Full comprehensive benchmarking appraisal method for CMMI

- ARC class A method

- Lead appraiser authorization program managed and administered by SEI

- SCAMPI version 1.1 deployed April 2002

SCAMPI Objectives

- Provide a common, integrated appraisal method capable of supporting appraisals in the context of internal process improvement, supplier selection, and process monitoring

- Provide an efficient appraisal method capable of being implemented within reasonable performance constraints.
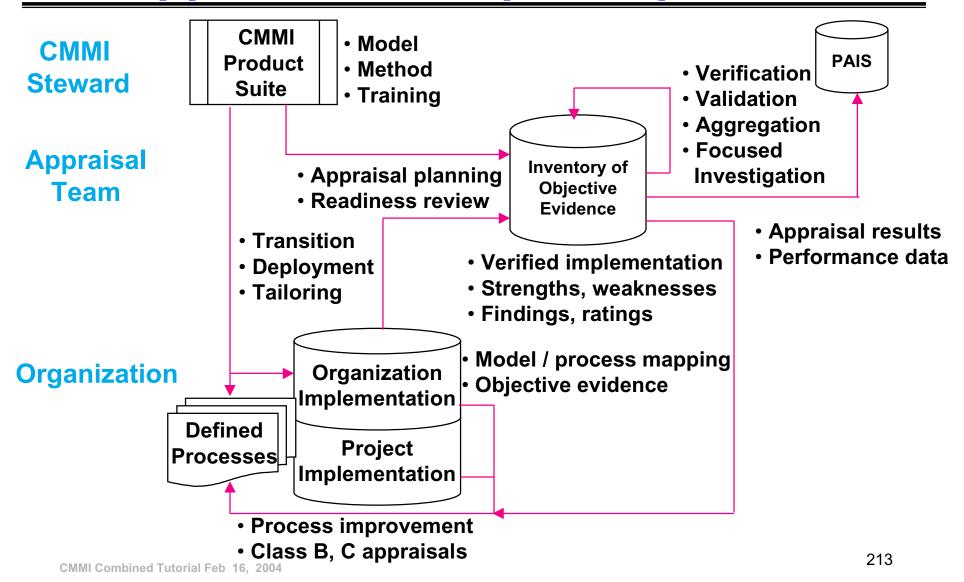
SCAMPI: New Features

• **Usage Modes: internal process improvement, supplier selection, process monitoring**

• **Reuse: enhanced ability to use existing model implementation knowledge and reduce the cost of the appraisal**

• **Disclosure: standard recommended set of appraisal data for disclosure of appraisal results**

• **Method Definition: Produced by CMMI Product Team (AMIT)**

Focused Investigation

- Emphasize effective data collection and management techniques throughout the appraisal process
  - Understand what objective evidence is available, and how it contributes toward implementation of model practices
  - Continually consolidate data to determine progress toward sufficient coverage
  - Focus appraisal resources where further investigation is needed
  - Avoid unnecessary or duplicated effort that does not contribute toward sufficient coverage or significantly greater confidence in appraisal results
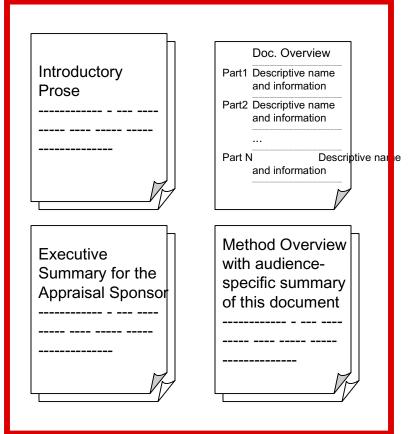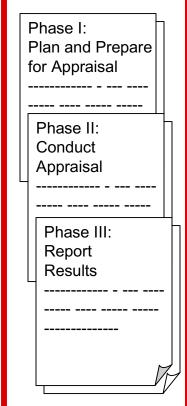
Appraisal Concept of Operations

CMMI Steward

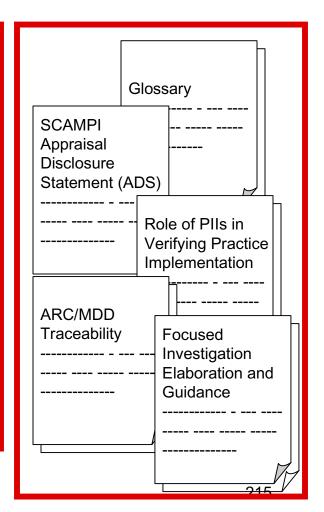**CMMI Product Suite**
- Model
- Method
- Training

PAIS

- Appraisal planning
- Readiness review

Appraisal Team

Inventory of Objective Evidence

- Verification
- Validation
- Aggregation
- Focused Investigation

- Transition
- Deployment
- Tailoring

- Verified implementation
- Strengths, weaknesses
- Findings, ratings

- Appraisal results
- Performance data

Organization

Organization Implementation

- Model / process mapping
- Objective evidence

Defined Processes

Project Implementation

- Process improvement
- Class B, C appraisals

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SCAMPI Phase Structure

•Phase I - Plan and Prepare For Appraisal

•Phase II - Conduct Appraisal

•Phase III - Report Appraisal Results

MDD v1.1 Outline

Introductory Prose
----------- - --- ----
----- ---- ----- -----

Doc. Overview

Part1 Descriptive name and information

Part2 Descriptive name and information

...

Part N   Descriptive name and information

Executive Summary for the Appraisal Sponsor
----------- - --- ----
----- ---- ----- -----

Method Overview with audience-specific summary of this document
----------- - --- ----
----- ---- ----- -----

Phase I: Plan and Prepare for Appraisal
----------- - --- ----
----- ---- ----- -----

Phase II: Conduct Appraisal
----------- - --- ----
----- ---- ----- -----

Phase III: Report Results
----------- - --- ----
----- ---- ----- -----

Glossary
----- - --- ----
-- ----- -----

SCAMPI Appraisal Disclosure Statement (ADS)
----------- - ---
----- ---- ----- --

Role of PIIs in Verifying Practice Implementation
-------- - --- ----
---- ----- -----

ARC/MDD Traceability
----------- - --- ----
----- ---- ----- -----

Focused Investigation Elaboration and Guidance
----------- - --- ----
----- ---- ----- -----

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SCAMPI MDD V1.1 Processes

- **Analyze Requirements**

- **Develop Appraisal Plan**

- **Select and Prepare Team**

- **Obtain and Analyze Preliminary Objective Evidence**

- **Prepare for Collection of Objective Evidence**

- **Examine Objective Evidence**

- **Verify and Validate Objective Evidence**

- **Document Objective Evidence**

- **Generate Appraisal Results**

- **Deliver Appraisal Results**

- **Package and Archive Appraisal Assets**

Sample MDD Process

3.1	Analyze Requirements
Purpose	Understand the business needs of the organization for whom the appraisal is being requested. The Appraisal Team Leader will collect information and help the appraisal sponsor match appraisal objectives with their business objectives.
Entry Criteria	Initial contact between the appraisal sponsor and authorized SCAMPI Lead Appraiser has occurred. The Lead Appraiser has been given access to members of the sponsoring organization, and asked to develop a proposal.
Inputs	• Sponsor, • Initial Requirements and Constraints, • Process-related Legacy Information
Activities	3.1.1. Determine Appraisal Objectives 3.1.2. Determine Appraisal Constraints 3.1.3. Determine Appraisal Scope 3.1.4. Determine Outputs 3.1.5. Obtain Commitment to Appraisal Input
Outputs	Appraisal Input
Outcome	The decision to proceed with the appraisal based on a shared understanding of the appraisal objectives, constraints and scope.
Exit Criteria	The appraisal input has been approved by the appraisal sponsor and placed under change management.

•**Example MDD process description based on information mapping approach.**

•**MDD processes contain the following, as applicable:**

• **Purpose - Entry Criteria - Inputs - Activities - Outputs - Outcomes - Exit Criteria**

• **Tools and techniques - Metrics - Verification & Validation - Records - Tailoring - Interfaces - Summary of activities**

•**Tags and format are used consistently to aid navigation and references.**

Sample MDD Activity

3.1.1   **Determine Appraisal Objectives**

Activity Description	The business needs for process improvement drive the requirements for the conduct of any given appraisal, and generally include one or more of three closely related factors:

- Reducing costs
- Improving quality, and
- Decreasing time to market

The fundamental premise of process improvement is that organizational processes significantly impact these factors.

A fair and objective characterization of the process in use in the organization(s) is the essential reason for conducting an appraisal. In addition to this motivation, a sponsor' s desire to conduct an appraisal could be driven by one or more of the following business related goals:

- Document a credible benchmark that reflects successful process improvement
- Evaluate areas of potential risk that may effect the performance of the organization
- Involve members of the appraised organization in improving the performance of the process
- Support specific decisions related to the direction of a new or existing improvement program
- Motivate a supplier to focus on process issues that affect their performance on a contract

Required Practices

Identify sponsor and relevant stakeholders, and establish communication.

Document business and appraisal objectives

Assure alignment of appraisal objectives to business objectives

Determine and document appraisal usage mode (internal process improvement, supplier selection, process monitoring).

Parameters and Limits

At least one communication between appraisal team leader and sponsor (Some usage modes may limit this significantly, others may re quire much more than one interaction).

- **Example MDD activity description based on information mapping approach.**

- **Content for MDD activities is structured as follows:**

- **Activity Description**

- **Required Practices**

- **Parameters and Limits**

- **Optional Practices**

- **Implementation Guidance**

Determination of Practice Implementation

- **Assumptions:**
  - the appraisal team understands the context in which the practice is being implemented, and
  - understands the practice intent.

- **The basic approach to determination of practice implementation is to:**
  - characterize the degree to which the practice is implemented, and
  - note any factors which should be considered in addition as the instantiation data is aggregated (strengths, weaknesses, etc.).

Characterizing Practice Implementation - 1

- Assign characterization values reflecting the extent of practice implementation for each instance

- Aggregate practice characterizations to organizational unit level using defined method aggregation rules

- Iterate and focus revisions to data collection plan

- Generate findings based on aggregation of weaknesses and strengths

Characterizing Practice Implementation - 2

Fully Implemented (FI)	• **Direct artifacts present and appropriate** • **Supported by indirect artifact and/or affirmation** • **No weaknesses noted**
Largely Implemented (LI)	• **Direct artifacts present and appropriate** • **Supported by indirect artifact and/or affirmation** • **One or more weaknesses noted**
Partially Implemented (PI)	• **Direct artifacts absent or judged inadequate** • **Artifacts or affirmations indicate some aspects of the practice are implemented** • **One or more weaknesses noted**
Not Implemented (NI)	• **Any situation not covered by above**

Practice Implementation Across Instantiations

Instantiation	Extent of Imp.	Preliminary Findings
Project 1	FI	(S) Strength words…
Project 2	PI	(W) Weakness words…
…		
Projects (other)	FI	

Aggregation to Goal

Practice	Extent of Imp.	Preliminary Findings
SP x.1-1	FI	(S) ….
SP x.2-1	PI	(W) …
SP x.3-1	FI	
SP x.4-1	FI	

SCAMPI Aggregation and Rating

CMMI

(optional)

**Maturity Levels
Capability Levels
Process Areas**

Goals

Final Findings

**Organizational
Unit Level**

Preliminary Findings	Char.
Weakness(es)	LI
Strength(s)	

Instantiation Level

Inst.	Direct		Indirect		Affirmation		Obs.	Char.
I1	Indicator(s)	✓	Indicator(s)	✓	Indicator(s)	✗	Weakness(es)	LI
I2	Indicator(s)	✓			Indicator(s)	✓	Strength(s)	FI
I3	Indicator(s)	✗	Indicator(s)	✗	Indicator(s)	✓	…	PI
I4	Indicator(s)	✓	Indicator(s)	✓			…	FI

(Practices)

Rating Goals

- *Goal ratings are a function of the extent to which the corresponding practices are present in the planned and implemented processes of the organization.*

- Team judgement is used to rate goals where the objective evidence doesn't render the outcome plainly obvious.
  - If all practices are FI, then the goal must be satisfied.
  - If all practices are NI, the goal can't be satisfied.
  - The conditions between the two extremes require professional judgment.

Aggregation and Consensus

Level of Consensus

- **Capability Level and/or Maturity Level Ratings**

Full Team

- **Goal Satisfaction Ratings**

Full Team

- **Practice Implementation Characterizations**
  - **(organizational unit level)**

Full Team

- **Practice Implementation Characterizations**
  - **(practice instantiation level)**

Mini-Team

Data Collection and Rating Concepts

- **Corroboration**

  - **Must** have direct artifacts, combined with **either** indirect artifact or affirmation

- **Coverage**

  - **Must** have sufficient objective evidence for implementation of each practice, for each instance

  - **Must** have face-to-face (F2F) affirmations (avoid "paper-only appraisals"):

    » At least one instance for each practice ("one column")

    » At least one practice for each instance ("one row")

    » or 50% of practices for each PA goal, for each project, have at least one F2F affirmation data point

Affirmation Coverage Rules - Summary

	Project-1	Project-2	Project-3	Project-4	Σ Row
PA.SPx.1-1					
PA.SPx.2-1					
PA.SPx.3-1					
PA.SPx.4-1					
Σ Column					

or, 2. "50% rule": $>$ 50% of PA practices for each goal, for each project, have at least one face-to-face (F2F) affirmation data point

1. "One Row, One Column"

Verification and Reporting

- Verification
  - Verify implementation of model practices at instantiation and organizational levels
  - Populate appraisal team inventory of objective evidence from organizational assets

- Reporting
  - Preliminary findings
  - Final findings

Tailoring SCAMPI

- SCAMPI users need to clearly understand the "degrees of freedom" they have when planning an appraisal
  - Where can there be no deviation from what is prescribed by the method?
  - Where can alternative implementations be considered?
  - Where are there opportunities for customization?

- Why alternative implementations and/or customizations?
  - Adapt method to special circumstances
  - Exploit opportunities for additional efficiencies
  - Take advantage of special circumstances

Appraisal Disclosure Form -1

- New to SCAMPI V1.1 – a standard set of information for use by appraisal sponsors in disclosing the results of an appraisal

- Benefits the community by recognizing that there is a minimum amount of information which must be disclosed in order for reasonable conclusions to be drawn or for comparisons to be made.

- A fully executed ADS is a required part of the appraisal report submitted by the SCAMPI Lead Appraiser to the SEI.

Appraisal Disclosure Form -2

- **Standard information content for SCAMPI Appraisal Disclosure Form:**
    - Appraisal sponsor and sponsor's organizational affiliation
    - Appraisal Team Leader, appraisal team members and organizational affiliations
    - Organizational Unit appraised
    - CMMI model (version, representation and domains)
    - Appraisal method used (e.g. SCAMPI V1.1)
    - Itemization of process areas rated and process areas not rated
    - Maturity level and/or capability level ratings assigned
    - Dates of onsite activity
    - Date of issuance of ADS

- **Signature of Appraisal Team Leader (as a minimum); appraisal team members and appraisal sponsor optional**

SEI Appraisal Program

- Goals:
  - Maximize value and use of SEI appraisal methods facilitated by qualified, trained individuals.
  - Transition appraisal technology in an effective manner, maintaining consistency and quality in the process.

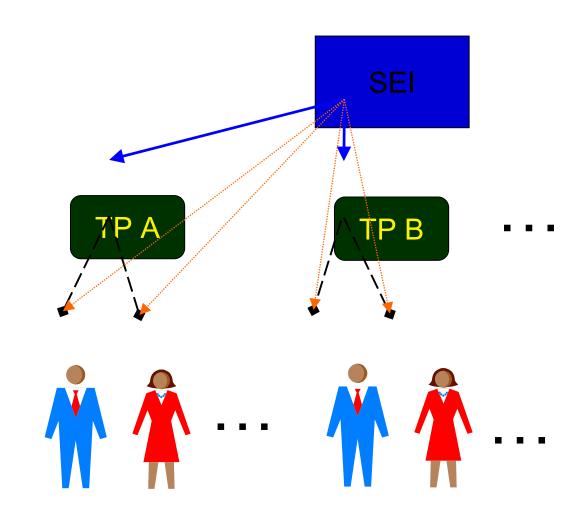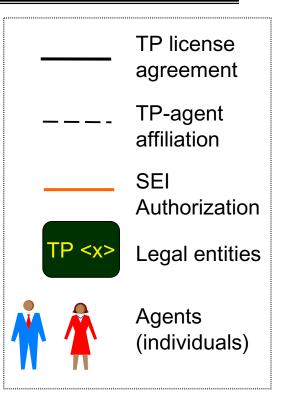- The SEI has added a SCAMPI track to its Appraisal Program for SCAMPI Lead Appraisers

SEI Transition Partners

- *To provide leadership in the transition of new software engineering technology into practice, Carnegie Mellon University/SEI licenses specific SEI technologies —typically training courses or appraisal services — to organizations that we call "transition partners."*
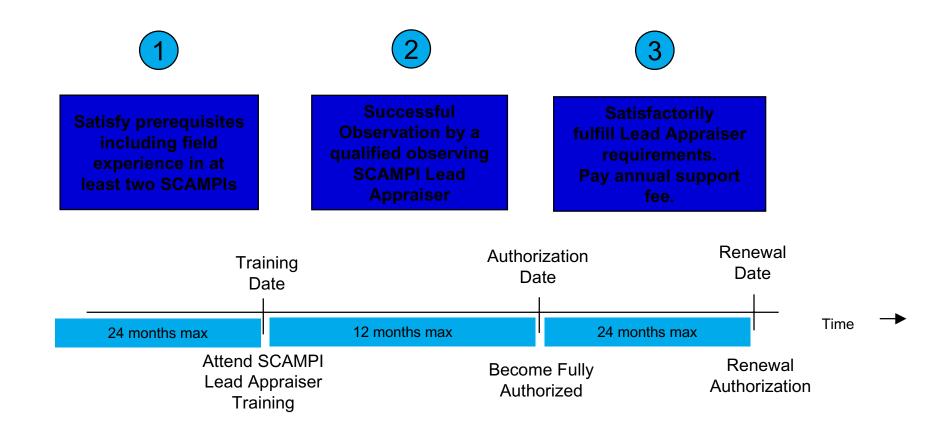
TP Infrastructure for CMMI

Authorization Costs

Course or Service	U.S. Government	U.S. Industry*	Int'l*
SCAMPI Lead Appraiser Training (5 days)	**$3200 per seat**	**$4,000 per seat**	**$6,000 per seat**
SEI Observation Fee (daily rate plus travel)	**$1,200/day + travel**	**$1,500/day + travel**	**$1,500/day + travel**
Annual Support Fee (per candidate or authorized Lead Appraiser)	**$2,400 – 1st** **$2,000 – 2nd+**	**$3,000 – 1st** **$2,500 – 2nd+**	**$4,500 – 1st** **$3,750 – 2nd+**

* The costs indicated above apply to U.S. Industry and International organizations with internal and/or commercial use licenses.

SLA Authorization Timeline

1

| Satisfy prerequisites including field experience in at least two SCAMPIs |

2

| Successful Observation by a qualified observing SCAMPI Lead Appraiser |

3

| Satisfactorily fulfill Lead Appraiser requirements. Pay annual support fee. |

Training Date

Authorization Date

Renewal Date

| 24 months max | 12 months max | 24 months max | Time → |

Attend SCAMPI Lead Appraiser Training

Become Fully Authorized

Renewal Authorization

Information Returned to the SEI

- The Process Appraisal Information System (PAIS) exists at the SEI as a repository of appraisal data.

- Strict confidentiality is maintained; results are reported in industry aggregates without attribution to project, persons, or organizations.

- The PAIS form, along with other required appraisal artifacts, are to be returned to the SEI within 30 days after each appraisal.

Renewal of Authorization

- Authorization as a Lead Appraiser is currently valid for a two-year period.

- Renewal depends upon satisfactorily meeting Lead Appraiser responsibilities and having an affiliation with an SEI Transition Partner with a license for delivering SCAMPI Appraisal services.

- Successful completion of any courses required for authorization renewal.

Renewal Considerations

• Sponsor feedback forms

• Team member feedback forms

• Random audit results

• Substantiated reports of any misuse of SEI materials and SCAMPI methodology

• Review of appraisal data returned to SEI

Tutorial Topics

•**Appraisal Requirements for CMMI**

•**SCAMPI V1.1 Overview**

•**SCAMPI Lead Appraiser Authorization**

→ •**Future Directions**

•**Data on Process Improvement**

Future Directions

- SCAMPI Class B and C Appraisals

- "Registered" Appraisals for Source Selection
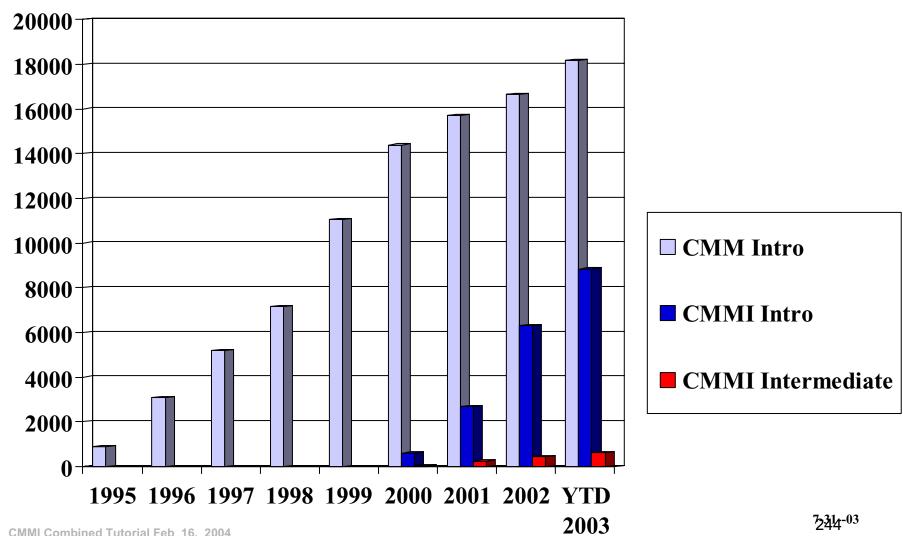
- SCAMPI appraisals on SW-CMM V1.1

Tutorial Topics

• **Appraisal Requirements for CMMI**

• **SCAMPI V1.1 Overview**

• **SCAMPI Lead Appraiser Authorization**

• **Future Directions**

➡ • **Data on Process Improvement**
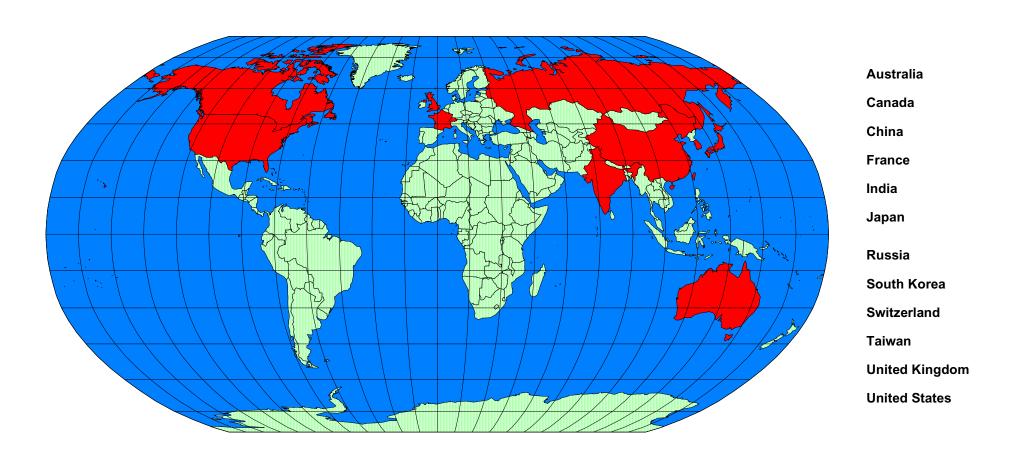
Intro to the CMM and CMMI Attendees (Cumulative)

Legend:
- CMM Intro
- CMMI Intro
- CMMI Intermediate

7-31-03

CMMI Appraisals Around the World

Australia

Canada

China

France

India

Japan

Russia

South Korea

Switzerland

Taiwan

United Kingdom

United States

Analysis conducted 13 June 2003

Geographic Distribution of Appraisal Results
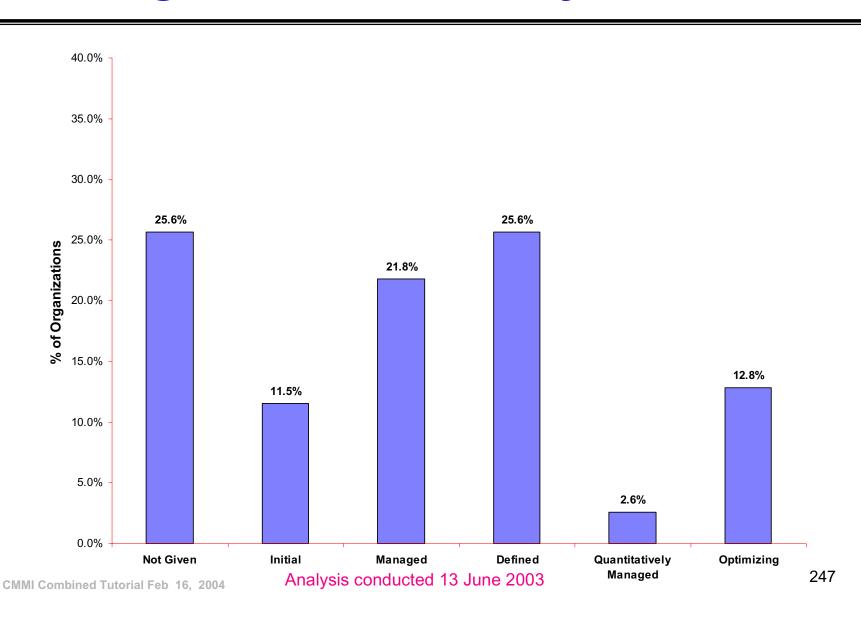
- **USA**   39
- **Japan**   21
- **India**   9
- **United Kingdom**   5
- **Australia**   3
- **China**   2
- **France**   2
- **Taiwan**   2
- **Canada**   1
- **Russia**   1
- **South Korea**   1
- **Switzerland**   1

Organization Maturity Profile

Analysis conducted 13 June 2003
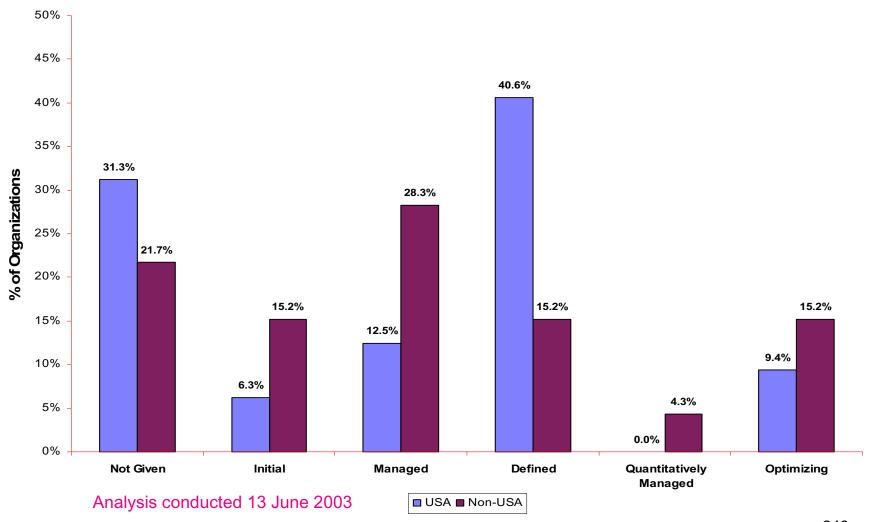
U.S. and Non-U.S. Organization Maturity Profiles

Chart: % of Organizations by maturity level (USA vs Non-USA)

Maturity Level	USA	Non-USA
Not Given	31.3%	21.7%
Initial	6.3%	15.2%
Managed	12.5%	28.3%
Defined	40.6%	15.2%
Quantitatively Managed	0.0%	4.3%
Optimizing	9.4%	15.2%

Analysis conducted 13 June 2003

SCAMPI^{SM} Version 1.1 Appraisals

- **93**   **Appraisals**

- **87**   **Organizations**

- **46**   **Participating companies**

- **12**   **Countries**

- **55%**   **Non-U.S. organizations**

- **Analysis conducted July 10, 2003**

Where are the Appraisal Results Coming From?
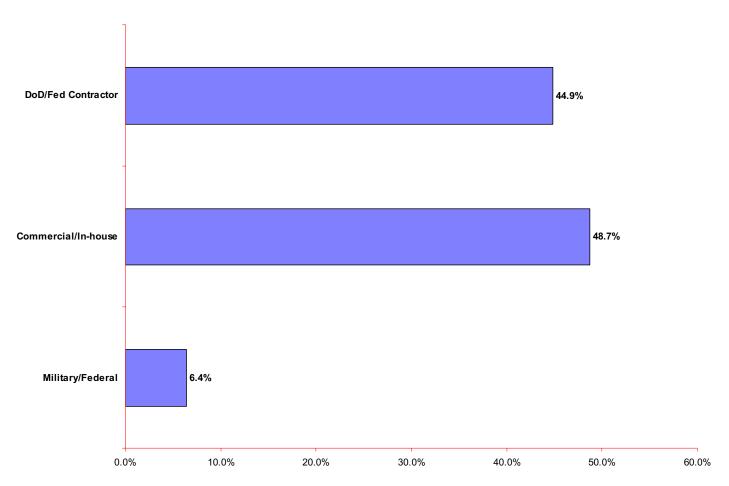
- 87 Organizations

- Commercial   41

- DoD Contractor   30

- Civil Contractor   8
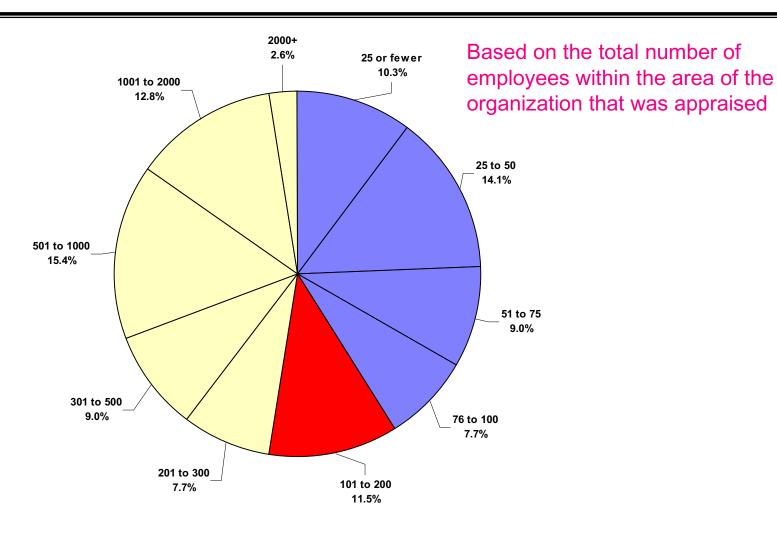
- Military Org   2

- Civil Org   2

- In House Dev   3

Reporting Organization Types

Bar chart showing reporting organization types:
- DoD/Fed Contractor: 44.9%
- Commercial/In-house: 48.7%
- Military/Federal: 6.4%

X-axis: 0.0%, 10.0%, 20.0%, 30.0%, 40.0%, 50.0%, 60.0%

Analysis conducted 13 June 2003

Organization Size

Based on the total number of employees within the area of the organization that was appraised

- 2000+ 2.6%
- 25 or fewer 10.3%
- 1001 to 2000 12.8%
- 25 to 50 14.1%
- 501 to 1000 15.4%
- 51 to 75 9.0%
- 301 to 500 9.0%
- 76 to 100 7.7%
- 201 to 300 7.7%
- 101 to 200 11.5%

Analysis conducted 13 June 2003
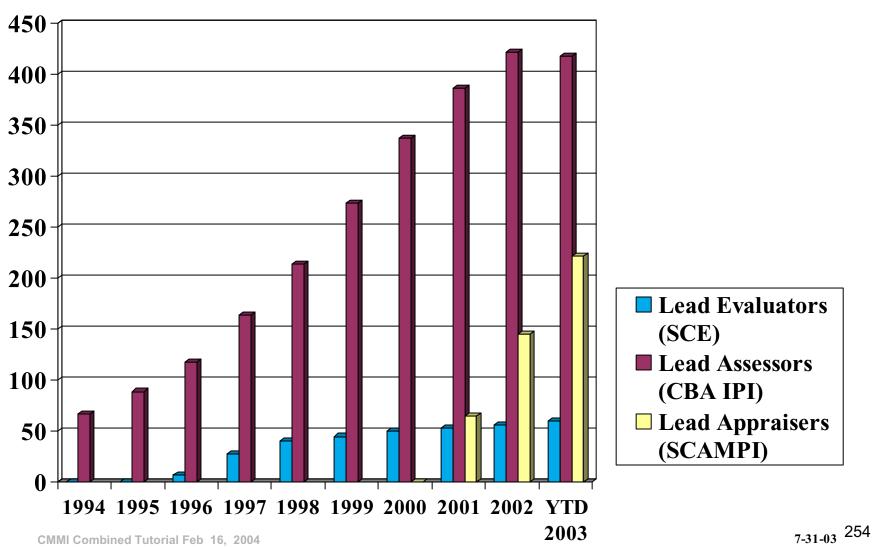
Appraisal Data Analysis

Selected Models
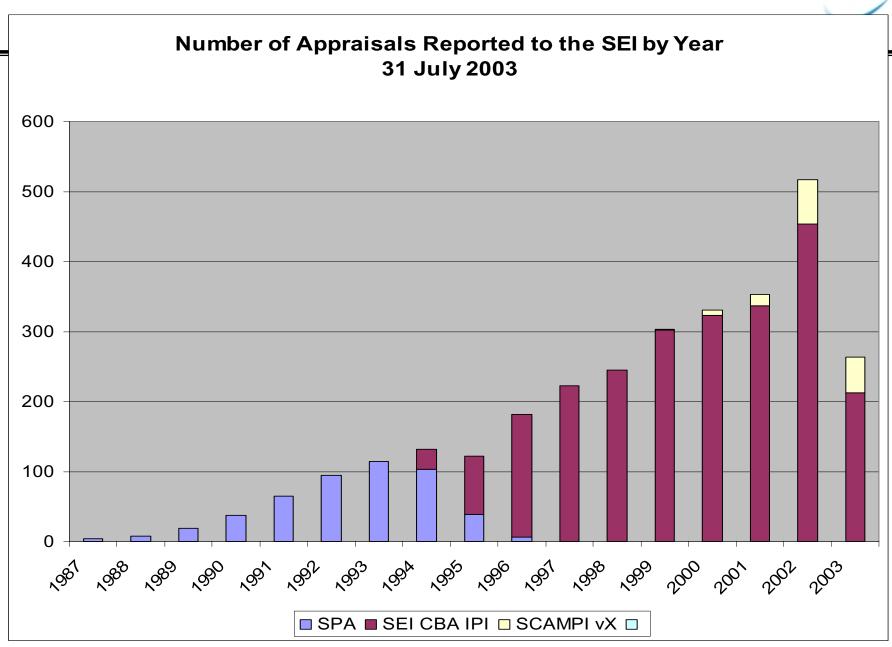
Model	Staged/Continuous
SW + SE	34/8
SW + SE + IPPD	1/1
SW + SE + IPPD + SS	1/2
SW + SE + + SS	5/2
SW	20/6
SE	8/2

Number of Lead Appraisers Authorized (Cumulative)

Legend:
- Lead Evaluators (SCE) — blue
- Lead Assessors (CBA IPI) — maroon
- Lead Appraisers (SCAMPI) — yellow

X-axis: 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, YTD 2003

Number of Appraisals Reported to the SEI by Year
31 July 2003

For More Information About CMMI

- Go to CMMI Website

  » **http://sei.cmu.edu/cmmi**

  » **http://seir.sei.cmu.edu/seir/**

  » **https://bscw.sei.cmu.edu/pub/bscw.cgi/0/79783**

  » **http://dtic.mil/ndia** (first second, and third annual CMMI Conferences)

  » **http://www.faa.gov/aio**